BULLETIN 58. FEBRUARY, 1901.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

GRAPES.

Address all communications to

S. C. EXPERIMENT STATION, Clemson College, S. C.

Freight and Express Office: Calhoun, S. C.

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Bulletins are not issued monthly, but at irregular intervals, not less than four a year.

Grapes.

C. C. NEWMAN.

The grape is one of the most satisfactory fruits that can be grown in this section, and with little care and attention those of the finest quality can be produced. While the grape does fairly well with little attention, we have no other fruit which responds so readily to proper care. We can always depend upon the grape for a certain crop. Although the young and tender shoots are sometimes killed by late spring frosts they at once put out strong shoots from buds which have been held in reserve for just such an emergency, and a good crop is produced from buds that would have remained dormant had the more prominent ones not been killed.

We have very few insects that attack the grape as compared with other fruits, and we have some varieties that are almost free from fungous diseases in this section. Some of our finest and most profitable varieties, however, are subject to rot and injuries from birds, and it has become necessary for us to employ means of combatting these in order that first-class fruit may be grown.

Experiments in spraying various varieties of grapes to prevent fungous diseases have been conducted here for the past two years, the beneficial effects of which are very marked. We can grow as fine grapes in this section as can be grown anywhere in the south and with as little expense, yet there is not one farmer in ten who grows enough grapes for his own use.

PROPAGATION.

Grapes are grown from seed, layers and cuttings. They are only grown from seed when we wish to originate new varieties. We may plant a dozen seed from a single vine and the probabilities are that no two vines grown from these seed will produce the same kind of fruit. While all our new varieties are produced from seed, the chances are that ninety-nine out of every hundred seedlings would be inferior to the parent plant.

Layering.—When one wishes to propagate a few vines layering is the surest and simplest method to adopt. Grapes of the Rotundifalia type and other hard wood sorts that are difficult to propagate from cuttings, are easily rooted in this way. Layering can be done at any time of the year, but fall and early spring layers are the best. It is done by opening out a trench three or four inches deep close to the vine and parallel to the row. A vigorous cane of last season's growth is selected and laid down in the trench and fastened with wooden pegs. The cane will put out a shoot from every joint and when they have grown about eight or twelve inches in length the trench is filled

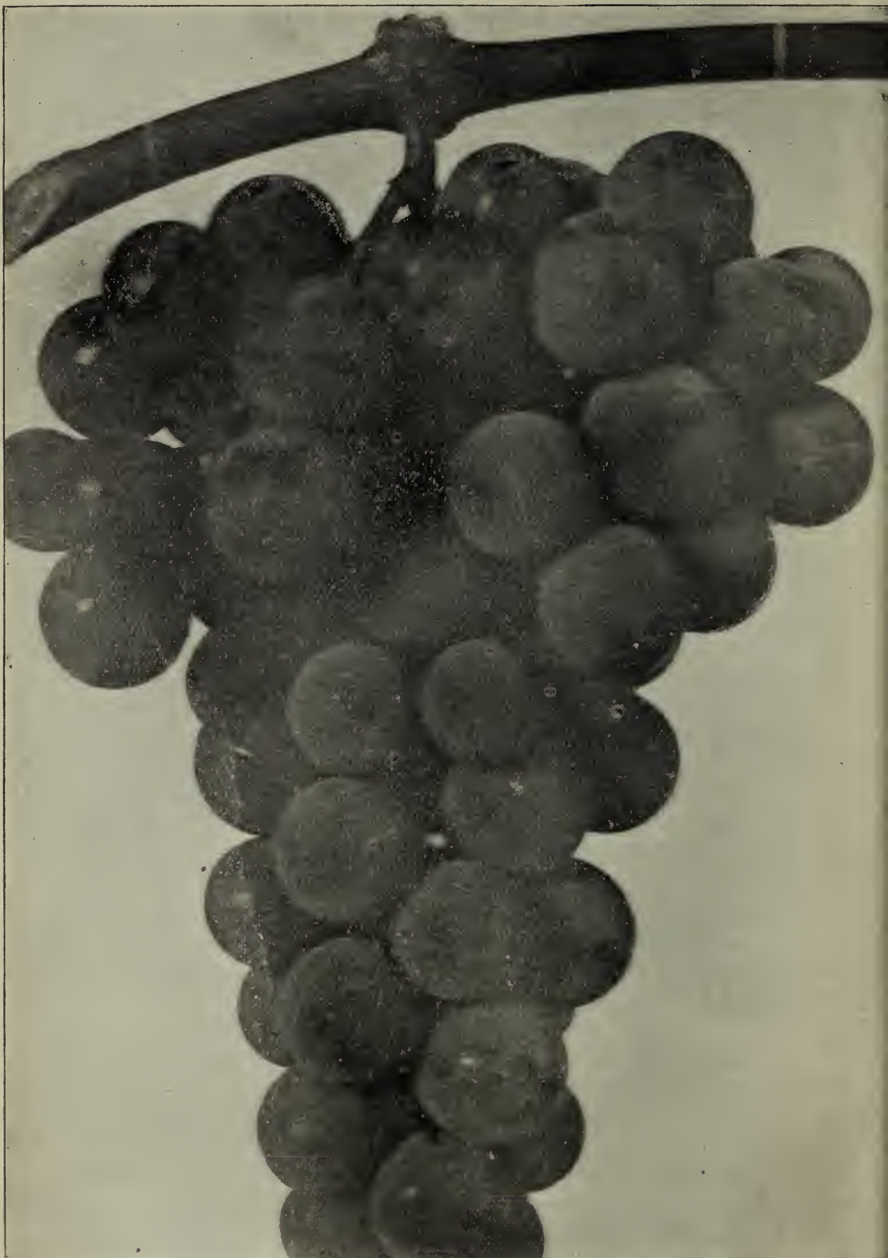


PLATE I.—Concord, Natural Size (Black).

with fine soil and packed well around the young shoots. Layers put down early in March will be ready to separate and transplant to a permanent place the following fall. Roots will be formed at the base of every shoot and the layer put down can be divided into as many plants as there are shoots on the cane. In order to hasten the formation of roots, a tongue about an inch long and 1-16 of an inch thick is cut at every joint on the opposite side from the bud, this assures the formation of roots at every joint and makes the plants more uniform in size.

Cuttings.—The most rapid way of propagating grapes is by cuttings, and this method is generally adopted. They can be made and put out at any time when the vines are dormant, and in this section that period extends from the first of November to the first of March. The best results, however, will be obtained from cuttings put out in November. Well ripened wood with joints of medium length should be selected, so that when the cuttings are made with three or four eyes they will be from eight to ten inches in length. In making cuttings care should be taken to keep the tops all the same way, for after the cuttings are made it is sometimes difficult to tell which is the top eye. A good plan in making cuttings is to have about one-half inch of wood below the bottom joint or eye and from one to one and a half inches above the top eye. If this is done there will be little trouble in keeping them straight. If, however, some of the cuttings should become reversed, one can easily tell the top from the bottom by close examination. It will be found that the eyes are just above the old leaf scars, so if this is kept in mind there can be no excuse for putting them out up-side-down. I have known of several instances where cuttings have been put out up side down and for that reason I have offered this precaution.

Select a rich, loamy soil and after thorough preparation lay off the rows four feet apart and open out a trench six or eight inches deep, according to the length of the cuttings. They are placed from two to four inches apart against one side of the trench and with the same slope. The trench is then filled about half full of soil and packed well about the cuttings with the foot. The trench is then filled with soil, leaving only about one inch of the cuttings uncovered.

If only a few cuttings are to be put out a V shaped trench can be made with a spade about six or eight inches deep, according to the length of the cuttings which are to be put as explained above.

Grafting.—This method is employed in propagating those varieties which do not grow and bear well on their own roots. It frequently occurs that weak growing and shy bearing variety can be made more vigorous and productive by grafting on a vigorous stock. Grafting is sometimes done to change an undesirable variety by cutting it back and grafting the desired sort on the old worthless vine. In this way a vine can be changed in one year and made to produce

PLATE II.—Niagara, Natural Size(White).

a good crop the second season. Grapes are propagated so easily by cuttings and layers, and as grafting is much more difficult, the latter method is practiced only to a very limited extent even by nursery men. Grafting grapes can best be done in the early spring, just before the buds begin to swell; but it can be done with fairly good results up to the time the young shoots begin to put out.

SELECTION OF VARIETIES.

For home use and local market we would select varieties that ripen in rotation, so as to have ripe grapes during the whole season. We select varieties that are less subject to disease and those which have proven to be vigorous, productive and of good quality.

In selecting grapes for shipping purposes, they must have all the good qualities of those for home use and must be of good form, compact and capable of being shiped long distances without injury. We must select our varieties with direct reference to the market we wish to supply.

In this section we can have an abundance of ripe fruit from the last of June to the last of September, and by bagging, the ripening period can be extended late into October.

We have tested many varieties of grapes here, some of which are worthless in this section, but a large majority of those tested do fairly well, and there is quite a number of our very best varieties that seem especially adapted to this locality.

The varieties below are mentioned in the order of their maturity, all of which have done well here and deserve special mention.

For Home Use and Local Market.—Early Ohio, Moor's Early, Perkins, Delaware, Niagara, Concord, Agawam, Ives, Lindley, Goethe and Norton's Va.

For Shipping.—Moor's Early, Perkins, Delaware, Niagara, Concord Agawam, Ives and Norton's Va.

For Wine.—Delaware, Perkins, Catawba, Concord, Elvira, Ives and Norton's Va.

The Perkins is almost free from disease here and the Concord, Ives and Niagara seldom rot to any great extent. These varieties are more subject to disease in some years than they are in others, but when the vines are properly sprayed these fungous diseases can be almost entirely prevented. Taking everything into consideration we consider these four varieties to be the most reliable for this sction.

The following varieties are well adapted to this section:

	Black.	Red.	White or Yellow.
Early.	Moors Early. Early Ohio. Champion.	Perkins. Delaware.	Diamond.

Medium.	Concord. Ives. Wilder. Merrimac. Carman.	Agawam. Lutie. Lindley. Berckmans. Salem.	Niagara. Elvira. Empire State.
Late.	Nortons Va. Ives, (when bagged).		Goethe.

LAYING OUT A VINEYARD.

Grapes do well on almost any soil that is fertile and well drained. A southern or eastern exposure is the most desirable, and if the land is sloping enough to be washed by the heavy rains, the rows should be laid off on a level about ten feet apart. The land should be thoroughly sub-soiled before planting in order to deepen the soil and give better drainage.

PLANTING AND CULTIVATION.

After the rows are laid off ten feet apart a trench about twelve or fourteen inches deep is made with a good "turn" plow and the vines planted eight feet apart in the row.

If bones can be had, several pounds should be put under each vine.

A well rooted one year old vine is the most desirable for planting. The vine is cut back to two or three eyes and the roots pruned to six or twelve inches in length so that they can be spread out in the soil and not be doubled up. The vine should be planted about two inches deeper than it stood in the nursery row, care being taken to

PLATE III.—Perkins, One-Fourth Natural Size (Pink).

pack the soil well about the roots. A stake four feet long should be driven up six or eight inches from each vine and in a row with them, so as to interfere as little as possible with the cultivation. When the vine begins to grow in the spring only one shoot is trained to the stake, the others being rubbed off so as to force the strength of the vine into the development of the selected shoot. The vineyard is kept clear of all weeds and grass by shallow cultivation. If one or two rows of bunch peas are grown between the rows of grapes each year and turned under in the fall it will vastly improve the mechanical condition of the soil and furnish the grapes with sufficient nitrogen. Just before preparing to plant peas between the rows of grapes in the spring about 250 pounds of Acid Phosphate and 200 pounds of Kainit per acre should be sown broadcast. If wood ashes can be had and a liberal supply be applied, the kainit may be omitted.

PRUNING, TRAINING AND TRELLISES.

It is our object in pruning and training to cause the vine to grow in such a way that the best possible results may be obtained. To do this we must build our trellis so as to interfere as little as possible with the cultivation of the vines. It must be constructed so that when the vine is properly pruned and trained the canes and fruit will not be crowded together, but will be spread out so as to admit ample sunlight for the development of the fruit and to facilitate spraying, bagging and gathering.

FOUR ARM SPUR SYTSEM.

We have experimented with twenty-one different methods of pruning and training, including trellises constructed in various ways, and believe this system to be the best for general purposes.

The posts are cut six feet long and are set sixteen feet apart and two feet in the ground, leaving four feet above. Two wires are used, the first is stretched two feet above the ground and the second about two inches from the top of the posts. The vines being planted, say in November, it will not be necessary to build the trellis until the followingNovember, or before the vines start to grow the following spring, the vines being trained to a stake or cane the first summer.

After the trellis has been built the vines are pruned by cutting them off even with the first wire and the vine tied to it. The next spring all the shoots are rubbed off the vine except the two top ones, which are left to form the arms for the lower wire. Care must be taken to keep these shoots tied to the wire in order to prevent their being broken off by the wind, and all the side shoots should be kept rubbed off the vine during the summer, so as to force the strength of the vine to the development of the two arms on the lower wire.

PLATE IV.—Second Year After Pruning.

The Second Year.—The vines are pruned by cutting the arms off about three feet from the main vine. If the vines are very vigorous the arms may be left three and one-half feet in length, but on less vigorous ones the arms should not be longer than two and one-half feet.

Plate IV shows a vine the second year after pruning with the arms left three feet long.

The next spring a vigorous shoot will be put out from each eye on the two arms, all of which are allowed to grow and bear fruit. If, however, two or more shoots should start from the same joint only one is allowed to grow, the others being rubbed off as soon as noticed. No shoots should be allowed to grow on the main vine below the first wire.

The vines should not be allowed to bear a heavy crop the third summer. We advise going over the vineyard soon after the blooming period and removing the small bunches and not allowing more than two bunches to remain on a cane.

The Third Year.—All of the canes that bore fruit the last season are cut back to one or two eyes, according to the vigor of the vine, except one cane near the centre of the vine, which is left to form the arms for the second or top wire. This cane is cut at the second wire and tied to it.

Plate V shows a vine the third year after pruning with the canes still in position, all the canes being spurred to one or two eyes except the one at the centre of the vine, which is cut even with the top wire. The next spring the arms for the top wire are formed from this upright cane in the same way as were the arms for the lower wire and are treated in the same way.

PLATE V.—Three Year Old Vine After Pruning With Canes Still in Position.

The Fourth Year.—The canes on the lower wire are spurred back to two eyes and the two newly formed arms on the top wire are cut off, leaving them the same length as the arms on the lower wire.

After the fourth year the frame of the vine being fully developed, the pruning is the same each year thereafter, the canes being spurred back to two eyes.

If for any cause one of the arms should die or be damaged in any way, it may be renewed by selecting a new cane near the main stem and training it to take the place of the old arm.

PLATE VI.—A Six Year Old Vine Before Pruning.

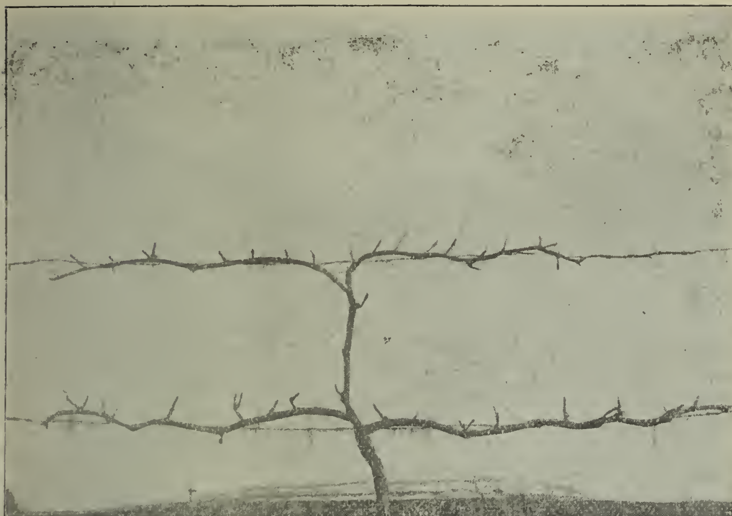


PLATE VII.—The Same Six Year Old Vine After Pruning.

In building a trellis we should select good sound posts and before setting them, the end to be put into the ground should be treated with some wood preservative such as tar or carbolineum.

Pruning can be done at any time when the vines are in a dormant condition, which, in this section is from about the middle of November to the first of March. Vines pruned in November will start to grow from five to ten days earlier the following spring than those pruned late in February. There is, however, little or no difference in the time of ripening of the fruit on the early and late pruned vines. There is some advantage in having the growth retarded in the spring as there is less danger of being injured by the late frosts.

The scuppernong and other grapes of the Rotundifolia family should be pruned as soon as the leaves drop in the fall. If they are pruned in February or March there is danger of the vines loosing so much sap as to cause their death. There are no injurious effects, however, if they are pruned early in November.

Summer Pruning is not practiced to any great extent, yet where one desires the best results from his vines it is very important. The growth should be controlled in the summer in order that the strength of the vine will not be wasted in making unnecessary growth. By rubbing off the surplus shoots with the thumb and finger as soon as they appear, and by pinching back the canes after they have formed four or five joints beyond the last bunch of grapes, the whole strength of the vine is forced to the development of the fruit and remaining parts of the vine.

PLATE VIII.

Summer pruning is especially important while the frame of the vine is being established, but will always more than pay for the trouble and expense involved.

Bagging Grapes.—This is done to protect them from the birds and fungous diseases and also to prolong the ripening period.

The Ives will keep perfectly sound in bags until late in October and the Norton's Va. will keep in perfect condition from three weeks to a month longer.

We bagged many varieties of grapes this year and find that some varieties are benefited by bags more than others. Birds are always more troublesome to black and red varieties of grapes than they are to the white. This year we bagged about half of our Delawares and fully ninety per cent of those not bagged were destroyed by birds, while those in the bags were in perfect condition. The Ives, Concord and Norton's Va. that were not bagged were also badly damaged by birds, while the Perkins, Niagara and Geothe were damaged very little. Grapes planted in an orchard or near trees and hedges are always damaged more by birds than those planted off to themselves. The bags are put over the bunches of grapes as soon as the fruit is set or when the grapes are the size of small shot.

Three-pound bags are used for the large bunch varieties, such as the Concord and Niagara, and two-pound bags are used for the smaller bunch varieties like the Delaware.

The bag is slipped over the bunch of grapes and the corners folded close about the stem and pinned. Bagging is very simple and inexpensive, the bags costing from sixty to seventy cents per thousand, and the pins about twenty cents per thousand.

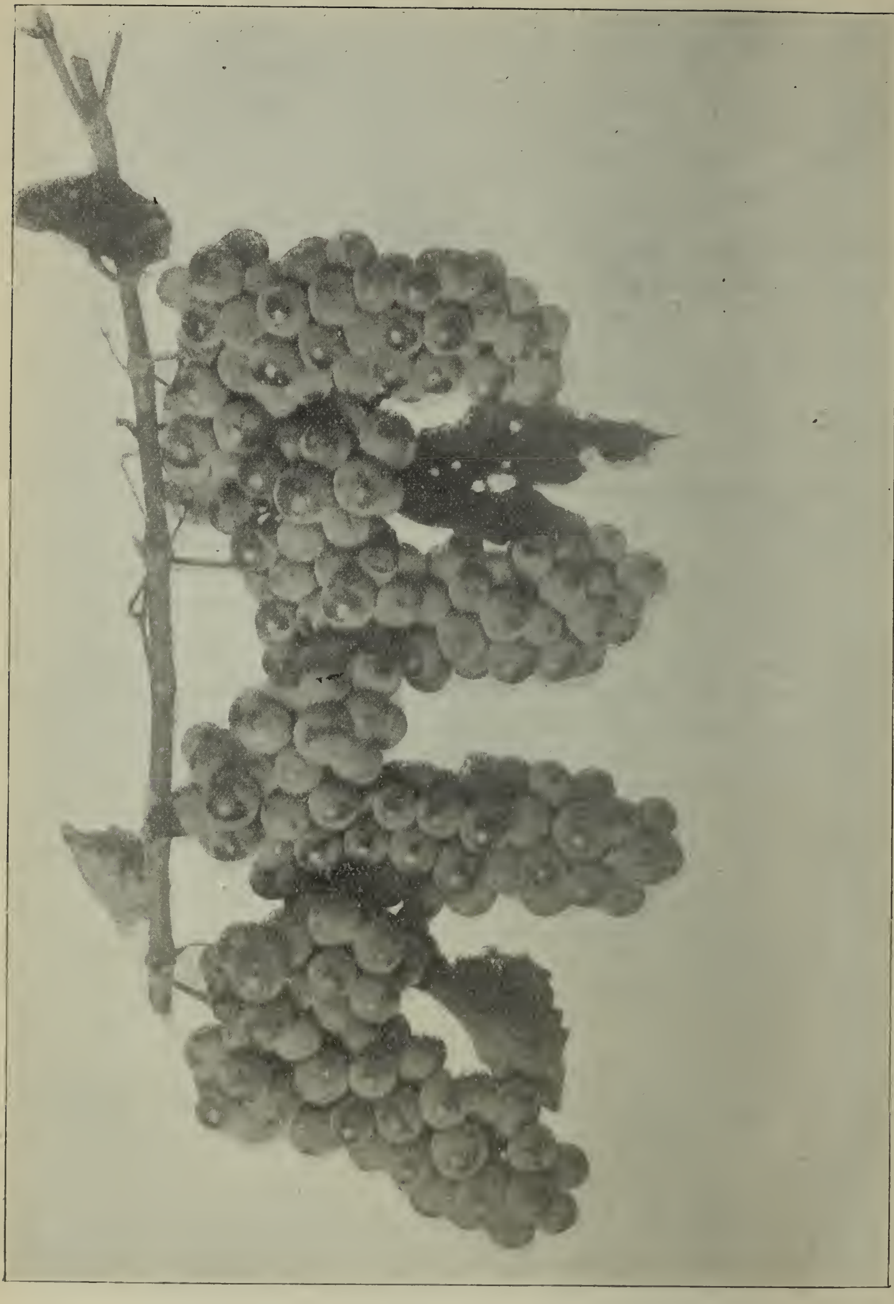
A man or boy with a little experience can put on from fifteen to eighteen hundred bags in a day, so the total cost of bagging a thousand bunches of grapes would not exceed $1.30. The grapes in bags ripen up more uniformly and always present a much more showy appearance than those not bagged.

Bagging will always prevent the grapes from rotting to some extent, but will not do away with the necessity of spraying when the variety bagged is subject to rot to a very great extent.

SPRAYING.

We have conducted experiments in spraying various varieties of grapes to prevent the fruit and leaves being destroyed by fungous diseases.

The first spraying was done just before the buds began to swell in the spring and the second application was made a few days before the vines began to bloom.



The third application was made as soon as the fruit was set, the grapes being the size of squirrel shot. The fourth spraying was done three weeks after the third.

Some vines were sprayed only once, and others two, three, four and five times.

The benefit of the spraying increased with the number of applications made up to the fourth, but we could see no advantage in the fifth application except in the late ripening varieties.

The most marked benefit in spraying varieties was with the Delaware. The unsprayed vines lost all of their leaves by the middle of June and all the fruit dried upon the vines before ripening.

Not one bunch of Delaware grapes ripened on an unsprayed vine, while the sprayed vines on the next row retained all their leaves and the fruit ripened beautifully.

The Bordeaux Mixture used in spraying the vines was made by the following formula:

6 lbs. lime.
4 lbs. bluestone (copper sulphate.)
50 gallons water.

The bluestone is dissolved by putting it into a cloth sack and hanging this in a barrel containing 25 gallons water. Slake the lime in another vessel and add 25 gallons of water to it. The lime and bluestone solutions are then mixed by pouring them slowly together in another barrel, stirring well as the two solutions are mixed.

PLATE XIX.—Barrel Pump Being Used to Spray Peach Trees.

How to Spray.—Thoroughness is the secret of success in spraying. In spraying the grapes one man drives and does the pumping while two men, one on each side of the wagon, do the spraying. In this way two rows of grapes can be sprayed at the same time.

The Bordeaux is forced through a nozzle which throws a very fine spray or mist. The nozzle should be kept moving over the vine and under the leaves until every part of the vine has been wet with the solution. When the solution begins to drip from the leaves very much the spray is stopped.

The barrel spray pump costs about fourteen dollars ($14.00) and when properly cared for can be used for a number of years. Hand pumps can be had for less money, but if there is much spraying to be done it will be much cheaper and far more satisfactory to use the barrel pump.

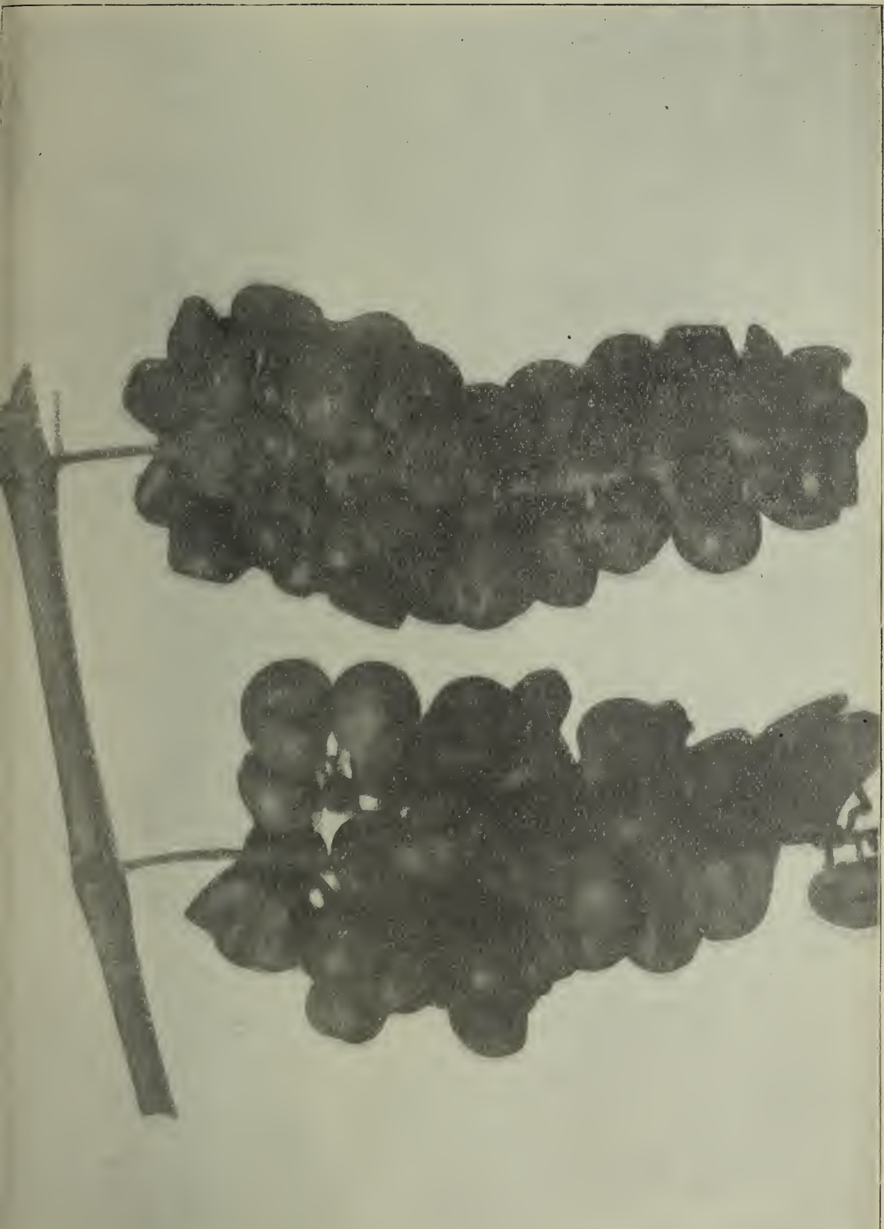


PLATE X.—Two Bunches of Delaware Grapes, Sprayed But Not Bagged. Two-Thirds of the Grapes Destroyed by Birds.

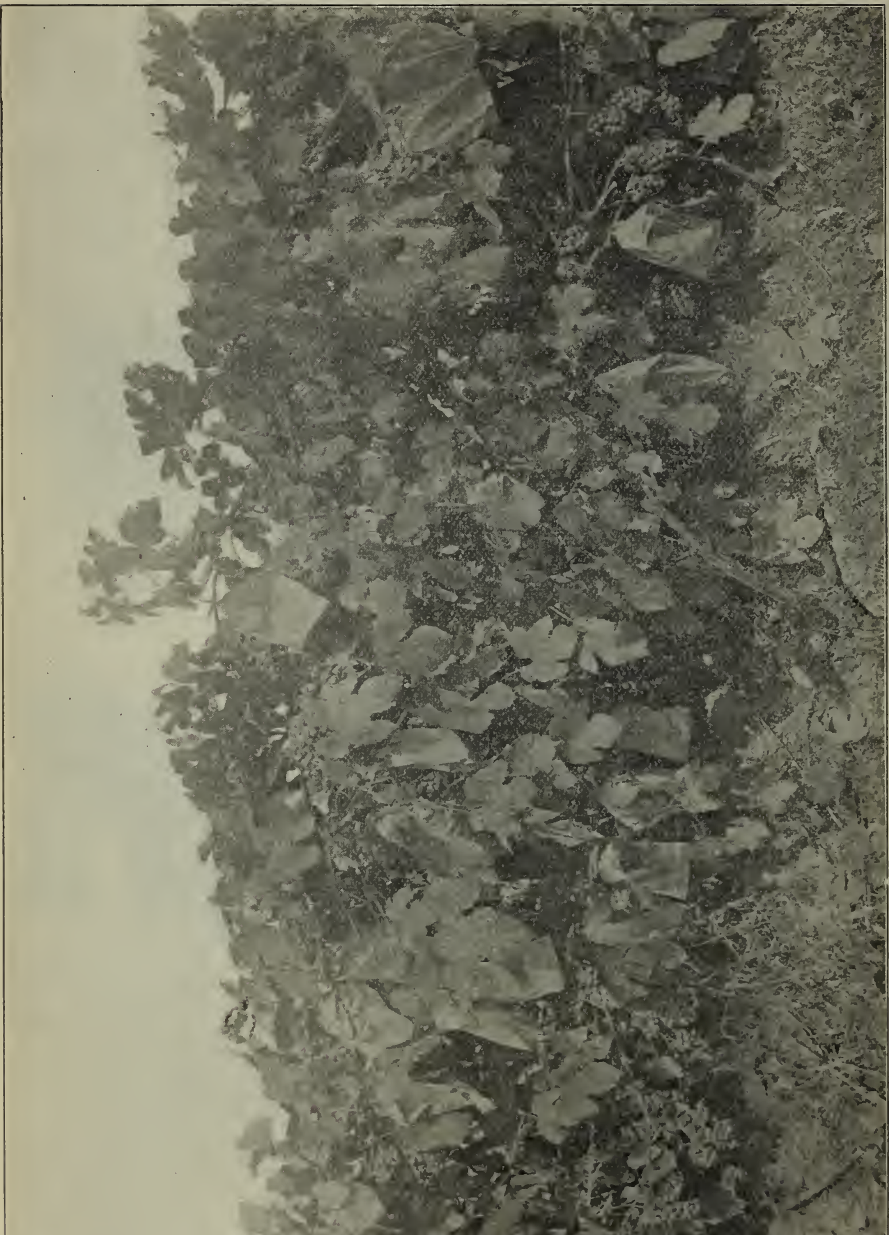


PLATE XII.—Delaware Vine not Sprayed. There is not a live leaf on the vine, All the grapes that have not rotted have dried up before ripening.

PLATE XIII.—Two Bunches of Black Eagle From a Sprayed Vine. Every Grape Perfectly Sound. Natural Size.

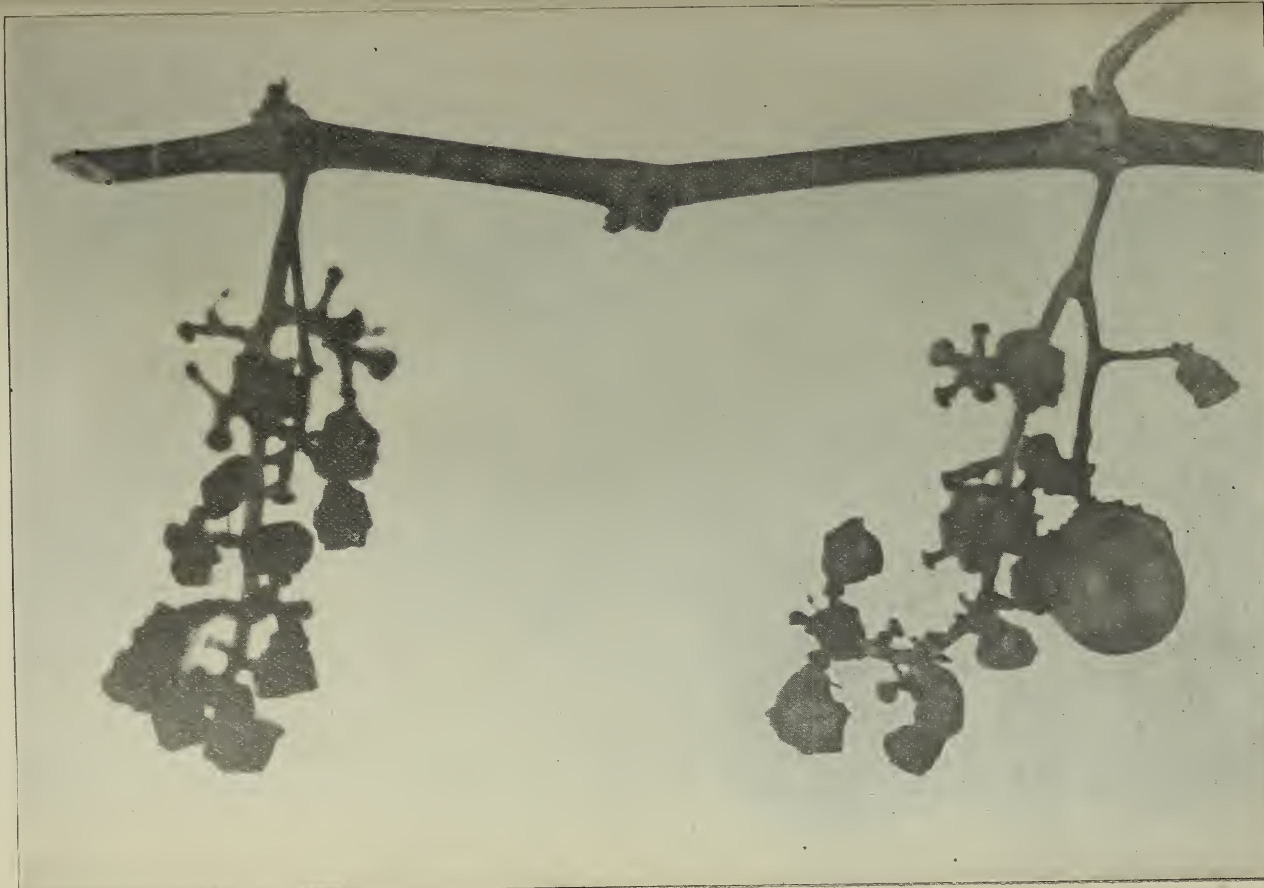


PLATE XIV.—Two Bunches Black Eagle From an Unsprayed Vine. Only One Sound Grape on the Bunch. Every Bunch on the Vine Rotted. Natural Size.

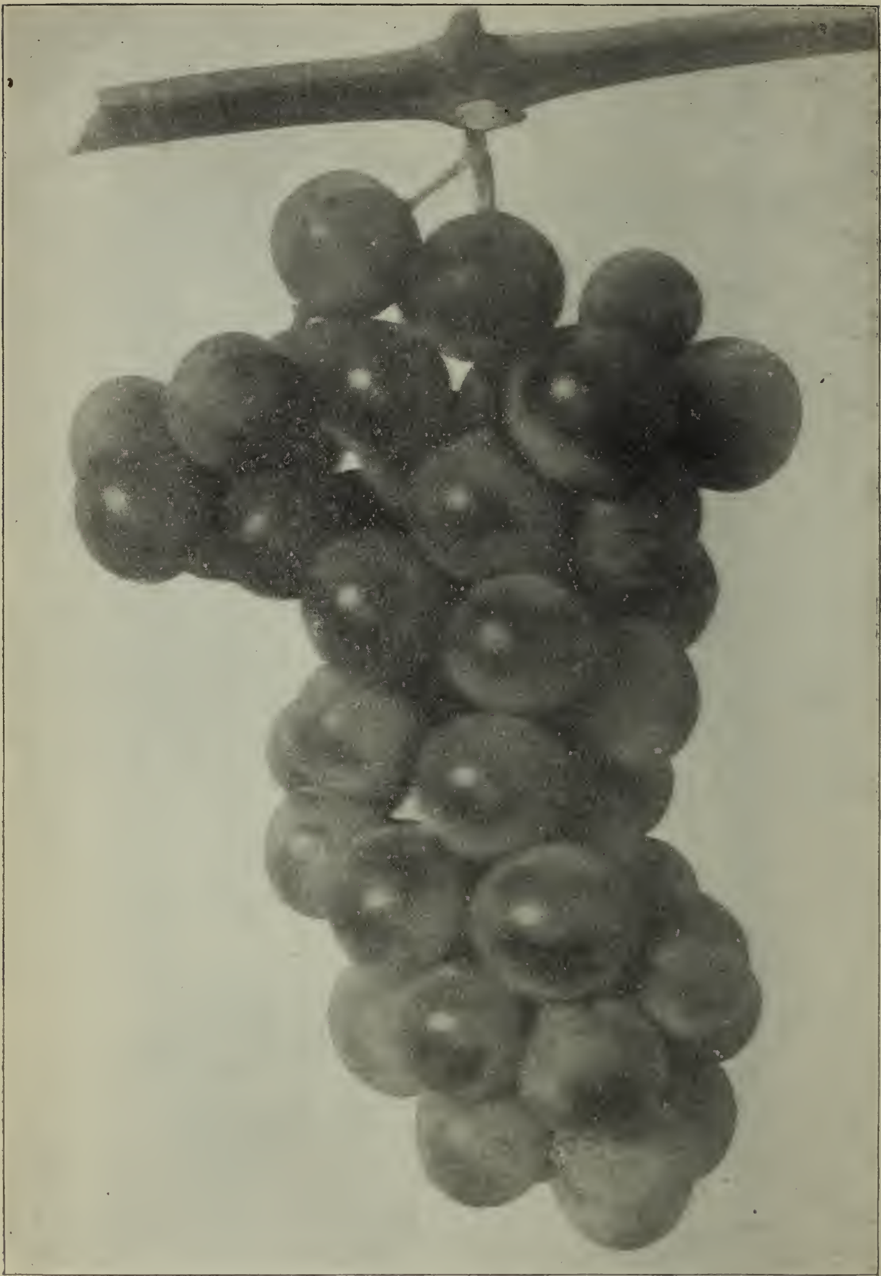
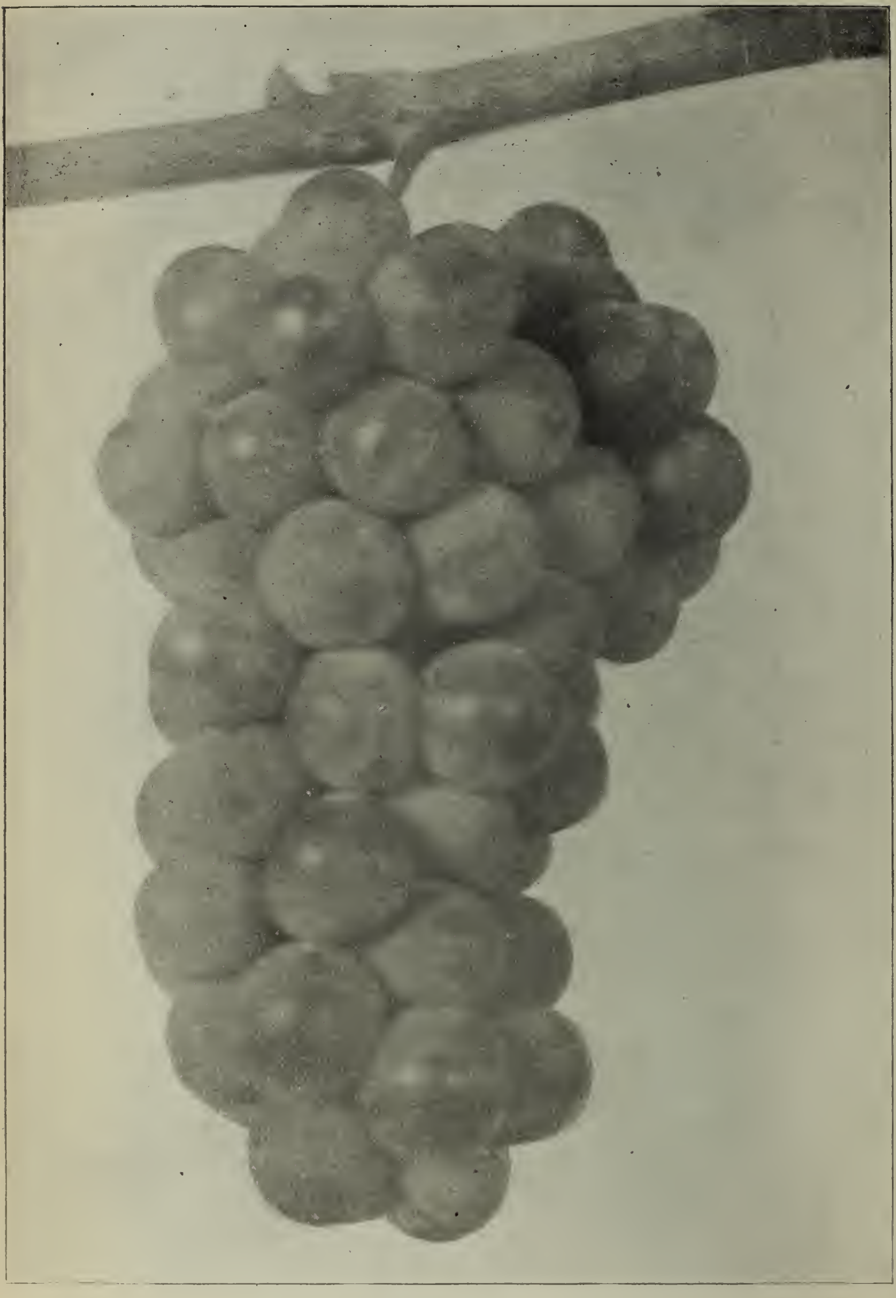


PLATE XV.—Agawam, Sprayed. Natural Size.

PLATE XVI.—Agawam, Not Sprayed. Natural Size



LATE XVII.—Perkins, Sprayed. Natural size.

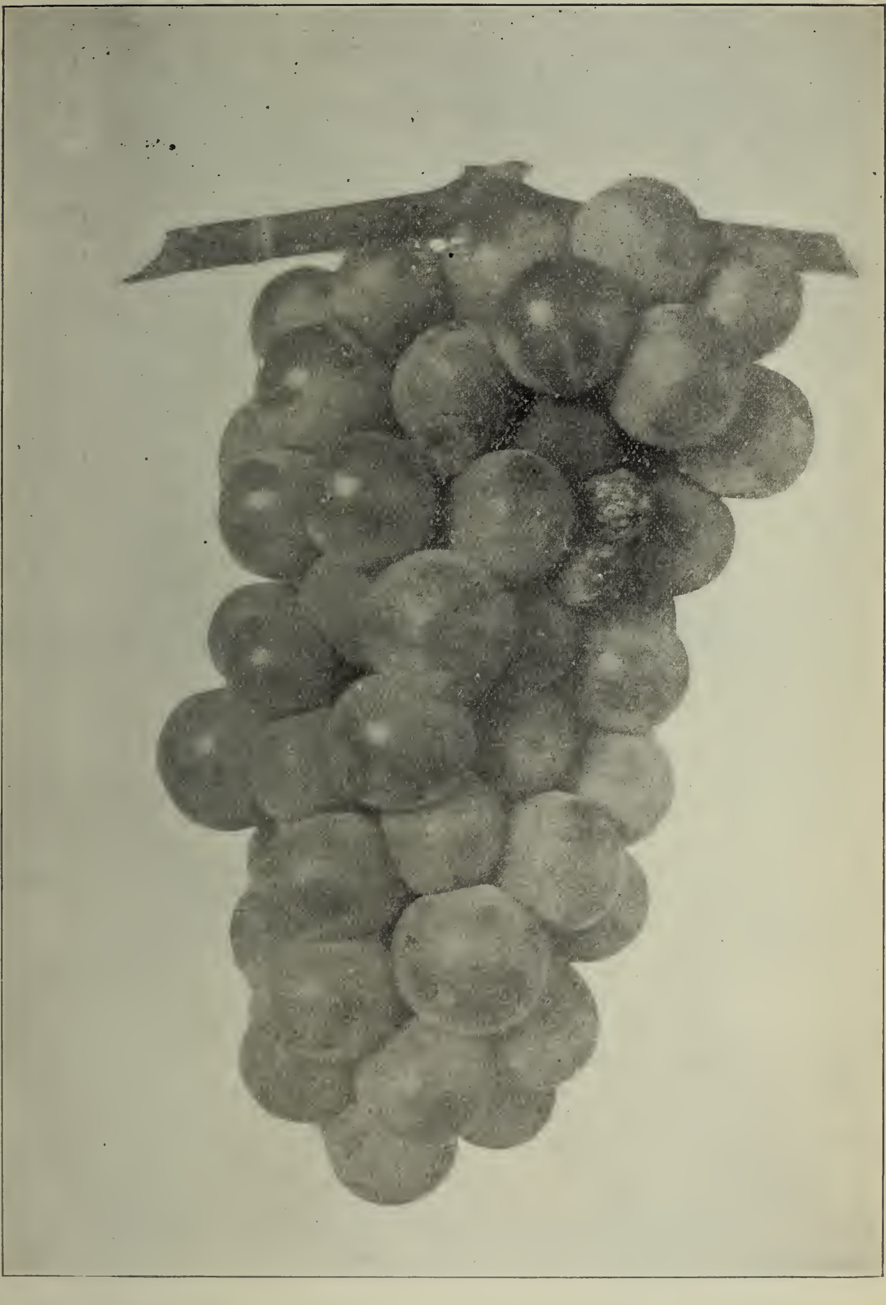


PLATE XVIII.—Perkins, Not Sprayed. Only Three Rotten Grapes on Bunch. The Perkins is Less Subject to Disease and Therefore Benefitted Less by Spraying Than Other Varieties. Natural Size.

BULLETIN 60. APRIL 1901.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

Analysis of Commercial Fertilizers

Address all Communications to
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Analyses of Commercial Fertilizers.

SEASON OF 1900–1901.

This bulletin contains the analyses of 186 samples of fertilizers collected this season. Part II of this report, giving the analyses of all other brands of fertilizers sampled this season, will be published as soon as the analytical work is completed. The samples are taken by the official inspectors from goods found in the open market throughout the State.

Our State law provides: "That if any fertilizer or commercial manure offered for sale in this State shall upon analysis prove deficient in any of its ingredients, and if by reason of such deficiency the commercial value thereof shall fall three per cent. below the guaranteed commercial value of said fertilizer, such fertilizer shall be deemed fraudulent, and any note or obligation given in payment therefor shall be collectible at law only for the amount of the actual commercial value as ascertained by the analysis, and the person or corporation selling the same shall be liable to the purchaser for such damages as may be sustained by reason of such deficiency."

In the tables, under the headings *found and guaranteed* one can compare at a glance the results of the analyses made in our laboratory and the relative commercial values calculated from these results, with the guarantees made by the manufacturers and the commercial values calculated from these guarantees. The figures in the tables represent pounds per hundred.

The commercial valuations for raw materials for this season are as follows:

	Per Unit.	Per Pound.
Phosphoric Acid (available)	$ .80	$ .04
Ammonia in Sulph. Ammonia	2.60	.13
" Equivalent to Nitrogen, in Nitrate Soda	2.40	.12

Ammonia Equivalent to Nitrogen in Dried Blood	2.50	.12½
" Equivalent to Nitrogen, in Cotton Seed Meal	2.40	.12
Potash in Muriate Potash	.90	.04½
" in Kainit	.90	.04½
" in Sulph. Potash	1.00	.05

In mixed fertilizers the ingredients are valued as follows:

Phosphoric Acid (available)	80	.04
Ammonia	2.50	.12½
Potash, soluble in water	.90	.04½

These are average cash retail prices of unmixed ingredients in raw materials, f. o. b. Charleston, S. C., October, 1900. They are based on actual quotations given by leading manufacturers and dealers on the materials used in manufacturing fertilizers. These valuations are required by law to be made October 1st of each year, and are used in calculating the commercial value of all fertilizers during the following season. Since all fertilizer material is subject to the fluctuations of the market, it is impossible to fix actual values for an entire season, hence these values should be regarded only as relative, although they may be considered as fairly approximate.

THE COMPOSITION OF COMMERCIAL FERTILIZERS.

The three ingredients which give to fertilizers their commercial value, are phosphoric acid, nitrogen and potash.

Phosphoric Acid.—This term, when used in connection with fertilizers, means a compound of phosphorus (P) and oxygen (O), known to chemists as anhydrous phosphoric acid or phosphoric anhydride (P_2O_5). This substance exists in fertilizers chiefly in combination with lime, forming phosphates of lime, though it occurs to some extent combined with oxide of iron and alumina, forming phosphates of these substances. It is occasionally found in small quantity in acid phosphates, especially when recently prepared, along with water as hydrated or true phosphoric acid, and in this condition is said to be "free."

Soluble Phosphoric Acid is the phosphoric acid which, whether free or combined, is readily soluble in water. In the manufacture of acid phosphates it is produced by treating insoluble phosphates, such as bone, bone-ash, bone-black, or

South Carolina rock with sulphuric acid. While the water-soluble phosphoric acid has exactly the same composition, no matter from what materials it is derived, yet an acid phosphate made from raw bone contains nitrogen in addition to phosphoric acid, and in this respect differs from an acid phosphate made from phosphate rock. The phosphoric acid in the two cases is identical in character and value as a fertilizer, but it is manifestly incorrect to designate as "dissolved bone" an acid phosphate made from phosphate rock. When an acid phosphate is put in the soil, the soluble phosphoric acid changes into "reverted" and insoluble phosphoric acid and is not liable to loss from leaching.

Reverted or Precipitated Phosphoric Acid is the phosphoric acid of phosphates which were once soluble in water, but which from chemical changes, have "gone back" into a condition insoluble in water. The phosphoric acid of these phosphates is soluble in a solution of citrate of ammonia of a certain strength and temperature, and is, together with the phosphoric acid of other phosphates which are soluble in this solution frequently spoken of as *citrate soluble* phosphoric acid.

Available Phosdhoric Acid—As the reverted phosphoric acid has been proved by experiment to be about equal in value as plant food to the water-soluble phosphoric acid, it is customary to designate the soluble and reverted together as available phosphoric acid. The acid phosphates made in this State contain from 10 to 15 per cent., most of them from 13 to 14.5 per cent. of available phosphoric acid. The acid phosphates sampled by our inspectors during the last six years, from goods made both in and out of the State, have shown an average of 13.30 per cent. of available phosphoric acid.

Insoluble Phosphoric Acid is the phosphoric acid of phosphates which are not soluble either in water or in solution of citrate of ammonia. The phosphoric acid of phosphate rocks is almost entirely in the insoluble condition; that of bones is largely in the same state, but on account of the changes which go on in the decay of bones, the phosphoric acid in them becomes available in the soil much sooner than that in ground phosphate rock. The law of this State does not include insoluble phosphoric acid among the essential ingredients of fertilizers.

Nitrogen occurs in fertilizers in three forms of combination: organic nitrogen, ammonia and nitrates.

Organic Nitrogen is the Nitrogen of animal and vegetable matters. The nitrogen of blood, flesh and cotton seed is easily converted in the soil into ammonia and nitrates and is therefore active as a fertilizer. The nitrogen of leather and horn is but slowly and with difficuly converted into available forms, and the use of these substances in the manufacture of commercial fertilizers is made a misdemeanor by the laws of this State. Dried blood of high grade contains about 13 per cent of nitrogen, equivalent to about 16 per cent. of ammonia. Tankage is very variable, containing 6 to 12 per cent. of nitrogen and more or less phosphoric acid according to the amount of bone present. Fish-scrap is also somewhat variable, but generally contains about 7 per cent. of nitrogen and nearly the same percentage of total phosphoric acid. Cotton seed meal contains from 6.5 to 7.5 per cent. of nitrogen, equivalent to from 7.9 to 9 per cent of ammonia. The average composition of 188 samples of the meal collected in this State during the last six years is as follows: Nitrogen 6.97 per cent,. equivalent to ammonia 8.46 per cent; available phosphoric acid, 2.52 per cent.; water-soluble potash 1.58 per cent. The meal contains in addition about 0.2 per cent. of phosphoric acid and about 0.3 per cent. of potash insoluble, according to our present methods of analysis. In order to calculate the percentage of ammonia in any case from a given percentage of nitrogen, multiply the percentage of nitrogen by 1.214.

Ammonia occurs in commercial fertilizers as sulphate of ammonia, and furnishes nitrogen in one of its most active forms of combination. The commercial article of high grade contains about 20.6 per cent. of nitrogen, equivalent to 25 per cent. of ammonia.

Nitrates.—The nitrate found in commercial fertilizers is nitrate of soda. It contains nitrogen in probably its most active state. It carries from about 15 to 16 per cent. of nitrogen, equivalent to from 18 to 19.5 per cent. of ammonia. When nitrogenous organic substances decay in the soil, their nitrogen becomes converted into ammonia and nitrates, the nitrates being the final product. Ammonia may furnish plants directly with nitrogen, but in most cases it is probably first changed into nitrates. It is generally believed that, with the exception of leguminous crops and certain low forms of plant life, all plants absorb their nitrogen from nitrates. While organic nitrogen and ammonia are not liable to be washed out from the

soil, nitrates are, in the absence of vegetation, readily removed by leaching. This is an important fact to remember in connection with the use of nitrate of soda as a fertilizer.

Free, or Uncombined Nitrogen exists in the air, of which it constitutes about four-fifths by volume. It is well known that leguminous plants, peas, beans, clover, etc., with the aid of certain micro-organisms, present in most soils, are able to gather nitrogen from the air. By a proper use of this knowledge, the necessity of buying nitrogen, which is the most expensive ingredient of fertilizers, is to a great extent avoided.

Potash.—When this term is used with reference to fertilizers it signifies a compound of potassium (K) and oxygen (O), known as potassium oxide (K_2O). While this substance may be regarded as existing in the sulphate, carbonate, and silicate of potash, it cannot be considered to exist in the so-called "muriate," which is really a compound of potassium and chlorine, properly called potassium chloride. As, however, the potassium in the muriate is chemically equivalent to a certain amount of potash, it is customary, for purposes of comparison, to reckon and report the potassium in it and in all other potash salts as potash (K_2O). Thus the high grade sulphate of potash of commerce is said to contain about 50 per cent., the muriate about 50 per cent., and kainit about 12.5 per cent. of potash. In all these salts the potash is soluble in water. Cotton-hull ashes contain potash chiefly in the form of carbonate. The samples of these ashes which have been examined in this laboratory contain about 18 per cent. of soluble potash and about 5 per cent. of potash insoluble in water. The other compounds of potassium on the market are sylvinite, chiefly a chloride, containing the equivalent of about 18 per cent. of potash; the sulphate of potash-magnesia, containing from 24 to 27 per cent.; the carbonate of potash-magnesia, containing about 18 per cent., and the silicate,* containing, according to the analysis of the only sample yet received at this laboratory, about 20 per cent. of potash. The percentages given refer to potash soluble in water.

While the potash in kainit is probably nearly all in the form of sulphate, it is associated with a large quantity of the chlorides of sodium and magnesium which make the effect of kainit, in some respects, like that of the muriate and sylvinite, which contain the potassium itself as chloride.

*This sample was a mixture of potassium silicate and peat.

Neither muriate of potash, sylvinite, nor kainit should be used when chlorides are objectionable, as for instance on tobacco, the burning qualities of which are injured by fertilizers containing chlorides. Although the potash salts are soluble in water, the potash in them is not readily washed out from the soil. The acids of the salts are leached out in combination generally with lime, but the potash is fixed by uniting with other constituents of the soil.

THE COMMERCIAL VALUATION OF FERTILIZERS.

At this Station, the valuation of a fertilizer consists simply in calculating the cost of the raw materials of good quality which will furnish the amount of available phosphoric acid, nitrogen, and soluble potash contained in the fertilizer. The nitrogen is estimated as ammonia. As the raw materials depend for their value solely upon the amount of the essential ingredients they contain, the valuation of a fertilizer is based upon the precentages of these ingredients as found by analysis and their average money values as determined for the season. See the following tables of analysis, and the table of values per pound and per unit, pages 3 and 4.

An example will make this plain. Suppose a fertilizer shows upon analysis the following composition, regard being paid only to the available phosphoric acid, ammonia and water-soluble potash.

ANALYSIS.

Available Phosphoric Acid	9.00 per cent.
Ammonia	2.42 per cent.
Potash Soluble in Water	2.16 per cent.

Multiply the per cent. (pounds per hundred) of each ingredient by 20. This will give the number of pounds of each ingredient in a ton of 2,000 pounds. Multiply the number of pounds thus found in the case of each ingredient by the value of that ingredient per pound, and add the products obtained. The result will be the valuation of a ton of the fertilizer. Thus:

	Pr Ct. (lbs per 100)	Pounds per ton.	Value per lb.	Value per ton
Available Posphoric Acid	9.00	180	\$0.04	\$7.20
Ammonia	2.42	48.4	.12½	6.05
Potash Soluble in Water	2.16	43.2	.04½	1.94
Relative commercial valuation per ton of 2,000 lbs				\$15.19

This is the average cost of the raw materials f. o. b. Charleston, S. C., October 1st, 1900.

Or, the calculation may be made in "units."

A unit is one per cent. of 2,000 pounds, that is, 20 pounds per ton. If, as in the foregoing table, one pound of available phosphoric acid is worth $0.04, 20 pounds, or one "unit" is worth $0.80, and so for the other ingredients. It is obvious that the number of pounds per hundred is the same in any case as the number of "units" per ton, both represent the same percentage. Therefore, multiply the per cent., or number of units, of each ingredient by the unit value of that ingredient and add the products. The sum will be the estimated value per ton. Thus:

	Per cent. Units	Value Per Units		Value Per Ton
Available Phosphoric Acid	9.00	$0.80	—	$7.20
Ammonia	2.42	2.50	—	6.05
Potash Soluble in Water	2.16	.90	—	1.94
Relative commercial valuation per ton of 2,000 lbs				$15.19

This is the average cost of the raw materials f. o. b. Charleston, S. C., October 1st, 1900.

As the market prices of raw materials are liable to fluctuation, the valuations based upon a constant price for the season are of course only approximate, but they show pretty well the relative commercial values of different fertilizers upon the assumption that in all cases materials of good quality have been used in the manufacture. The difference between the valuation and the selling price at seaboard represents the charges for manufacture and profits. The commercial value of a fertilizer does not bear a strict relation to its agricultural value in every case, for while the former depends largely upon trade conditions, the latter depends upon the fertilizing effects produced, and these can be determined only by experience. In purchasing fertilizers, farmers should be governed not only by the selling price, but also, and especially, by the composition as guaranteed or shown by analysis. They should buy only from well-known and honorable manufacturers, and should select fertilizers containing such proportions of the essential ingredients as experience has shown to be best adapted to their soils and crops.

M. B. HARDIN.

Regulations Governing the Sales of Commercial Fertilizers in South Carolina.

SEASON 1900.—1901.

1. All persons or companies engaged in the manufacture or sale of commercial manures are required to pay to the State Treasurer twenty-five cents per ton on every ton of such fertilizer sold or offered for sale in South Canolina.

2. Every bag, barrel or other package of such fertilizer shall have thereon a plainly printed label or stamp which shall truly set forth the name, location, and trade mark of the manufacturer, also the chemical composition of the contents of such package, and the *real percentage* of any of the following ingredients asserted to be present, to wit: Soluble and precipitated phosphoric acid, soluble potassa, ammonia or its equivalent in nitrogen, together with the date of its analysis; and every package must also bear the inspection tax tag issued by the Board of Trustees of C. A. C.; and must be branded "High Grade," "Low Grade," or "Standard," as required by Act of 1898.

3. All chemical compounds sold or offered for sale as fertilizers, including burnt marl, kainit, ground bone, fish scrap, tankage, cotton seed meal, etc., are subject to the payment of the inspection tax.

4. All applications for tax tags must be made to State Treasurer, Columbia, S. C., and all checks, money orders, etc., in payment therefor, must be made payable to his order.

5. Manufacturers and dealers are required to send the guarteed analysis of their goods, to be filed in this office, before making application for tax tags. Blanks for this purpose will be furnished on application to this office. Manufacturers are also required to send to this office a true sample of each and every brand of fertilizer or commercial manure of not less than one pound intended to be offered for sale wilhin the State during the season.

6. Samples of fertilizers for analysis will be drawn by agents, appointed by the Board of Fertilizer Control, from any lots of fertilizers found on the market in any part of the State.

7. Our fiscal year begins Nov. 1st, and all fertilizers sold after that date must bear the tax tag of the current year.

8. Manufacturers or dealers having tax tags left over from last season may return them to this office and exchange them for tags of the present season.

9. All persons, companies or corporations engaged in the manufacture or sale of fertilizers or commercial manures shall cancel all tags or stamps used as evidence that said inspection tax has been paid, by stamping such tags or stamps with the name of the person or persons, company or corporation selling, shipping, or manufacturing; also, the date of shipment or delivery. No railroad or common carrier shall receive for shipment or delivery from any person or persons, company or corporation, any fertilizers or commercial manures with the tags or stamps bearing date of cancellation thirty or more days prior to delivery for shipment.

10. All communications for this office should be addressed to the undersigned, Clemson College, S. C.

J. P. SMITH, Secretary.

By order of the Board of Control.

Farmers' Samples.

Attention is called to the following Act of the Legislature, approved Feb. 19, 1900:

AN ACT

To Provide a Means Whereby Any Purchaser, in This State, of Any Commercial Fertilizers or Manures, May Have the Same Analyzed by Clemson Agricultural and Mechanical College, Free of Costs, and to Provide a Penalty for Delivering Fertilizers or Manures Short in Ingredients Appearing on Sack or Vessel Holding Same.

SECTION 1.

Be it enacted by the General Assembly of the State of South Carolina: That from and after the passage of this Act, any citizen of this State who shall purchase any Commercial Fertilizers or Manures, shall have the right to have the same analyzed by Clemson Agricultural and Mechanical College by taking a sample of same within ten days of receipt thereof from at least ten per cent. of such fertilizers in the presence of at least two disinterested witnesses. One to be chosen by the purchaser and one by the seller, who shall certify that such sample was taken from such fertilizers or manures, which certificate, with the sample, shall be sealed by a third disinterested party in the presence of said witnesses, and directed to Clemson Agricultural and Mechanical College.

SECTION 2.

The said college shall have the said sample analyzed free of cost, and within three months after receiving the sample, supply the purchasers of such fertilizers or manures with a certificate giving the per cent. of the different fertilizing ingredients of same, signed by the Chemist of Clemson Agricultural and Mechanical College, which certificates shall be admissable as evidence in all suits relative to such fertilizers or manures whether the same be instituted by the vendor or purchaser of same.

SECTION 3.

That any vendor of Commercial Fertilizers or Manures

whose goods or wares fall short to the extent of ten per cent. in any fertilizing ingredient guaranteed by the analysis appearing on the sack or vessel holding same, when delivered to the purchaser, shall forfeit one-half the sale price thereof, to be recovered by suit or set up as a counter-claim to an action for the purchase price of such fertilizers or manures.

SECTION 4.

Be it further enacted: That if any seller or vendor of fertilizers or commercial manures shall refuse, decline or neglect to choose a witness, as provided in SECTION 1, after having been notified or requested by the purchaser so to do, then he or they shall have forfeited their rights so to do, and the purchaser shall select two witnesses, who shall select the third witness, who shall proceed to take samples as herein before povided. All samples of fertilizers drawn under the provision of this Act shall be subject to such other rules as may be prescribed by the Board of Trustees of Clemson College not inconsistent with the provisions of this Act.

SECTION 5.

All Acts and parts of Acts inconsistent with this Act be, and the same or hereby repealed.

Approved the 19th day of February A. D. 1900.

Fertilizer Analysis For Farmers.

DIRECTIONS FOR DRAWING FARMERS' SAMPLES.

Take portions of the sample from at least one sack in every ten of the lot sampled. If there should be less than ten sacks in the lot, portions should be taken from several sacks. Mix the portions thoroughly and from the lot select about one quart. Place this in a clean wide-mouth bottle or jar and seal tightly.

Place the name and address of the sender, the number of the sample (if more than one sample is sent), the date of drawing, where drawn, and the names of the ingredients claimed (Phosphoric Acid, Ammonia, and Potash, either or all of them), on each bottle.

The samples must be drawn in the presence of two witnesses, one representing the purchaser and one the seller, as required by law.

Pack securely in a box and forward by express prepaid to Fertilizer Department, C. A. C., Calhoun, S. C. Samples of fertilizers drawn in accordance with above directions will be analyzed and the results will be mailed to persons sending the samples as early as possible without interfering with the work on official samples.

No samples will be analyzed unless these rules are complied with.

No charge will be made for the analysis.

Instructions and blank certificates may be obtained by applying to the Fertilizer Department, Clemson College, S. C.

TABLE I. Ammoniated Fertilizers.

Sample No.	Brand of Fertilizer	Moisture	Found: Phosphoric Acid: Total	Insoluble	Soluble	Reverted	Available	Nitrogen	Equivalent to Ammonia	Potash Soluble in Water	Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Ammonia	Potash Soluble in Water	Relative Com. Value per Ton	Dates Sampled	Sampled At	Manufacturer	Manufactured At
3	Acme Special Grain Fert....	12.07	9.24	0.68	5.60	2.96	8.56	1.35	1.64	2.01	12.76	8.50	2.00	2.00	13.60	Oct. 5	Greenwood....	Acme Mfg. Co..........	Wilmington, N.C.
157	Acme Soluble Bone........	13.38	9.54	0.70	6.55	2.29	8.84	2.19	2.66	1.82	15.36	8.00	2.50	1.00	13.55	Jan. 22	Nichols........	Acme Mfg. Co..........	Wilmington, N.C.
153	Acme Fert. for Tobacco......	13.45	8.40	0.76	5.44	2.20	7.64	2.57	3.12	2.14	15.84	8.00	3.00	2.50	16.15	Jan. 21	Darlington.....	Acme Mfg. Co..........	Wilmington, N.C.
214	Anderson High Grade Fert...	9.16	11.35	1.88	7.19	2.28	9.47	2.42	2.94	1.14	15.97	8.00	2.50	1.00	13.55	Feb. 2	Anderson	Anderson Fert. Co.......	Anderson, S. C.
241	Arrow Brand Guano..........	14.38	11.76	2.24	5.80	3.72	9.52	2.14	2.6	1.31	15.30	8.00	2.50	1.00	13.55	Feb. 12	Troy...	F. S. Royster Guano Co..	Norfolk, Va.
33	Ashepoo Guano..............	14.28	10.39	1.28	6.56	2.55	9.11	2.07	2.51	1.21	14.65	8.00	2.50	1.00	13.55	Jan. 10	Sumter.... ..	Ashepoo Fert. Co.	Charleston, S. C.
17	Ashley Blood Guano..........	11.47	12.19	2.74	4.66	4.79	9.45	1.89	2.29	1.94	15.03	8.50	2.00	2.00	13.60	Oct. 17	Ninety-Six....	Va. Car. Chem. Co.......	Charleston, S. C.
236	Atlantic Cotton Grower......	12.28	9.04	0.79	5.23	3.02	8.25	2.48	3.01	1.38	15.37	8.00	2.50	1.00	13.55	Feb. 9	Donalds...	Atlantic Chem. Co.......	Norfolk, Va.
156	Baughs H.G. Tobacco Guano..	11.13	11.13	1.28	5.36	4.49	9.85	2.54	3.08	3.02	18.30	8.00	3.00	3.00	16.60	Jan. 21	Darlington....	Baugh & Sons Co.	Norfolk, Va.
272	Bone and Peruvian Guano....	14.2	10.45	1.87	5.91	2.67	8.58	1.93	2.35	2.39	14.89	8.00	2.00	2.00	13.20	Feb. 1	Camden	American Fert. Co.......	Norfolk, Va.
170	Bradley Ammoniated Fert....	14.46	11.77	1.89	7.39	2.49	9.88	1.92	2.33	1.64	15.21	9.00	2.25	1.00	13.72	Jan. 25	Marion	Bradley Fert. Co.	Boston, Mass.
36	Bright Leaf Tobacco Grower..	13.8	11.49	1.06	8.16	2.27	10.43	1.97	2.39	2.80	16.84	8.00	3.00	3.00	16.60	Jan. 11	Florence	Norfolk & Car. Chem. Co..	Norfolk, Va.
221	Carolina Ammoniated Bone..	16.25	12.47	1.91	7.61	2.95	10.56	1.70	2.07	1.18	14.69	8.00	2.50	1.00	13.55	Feb. 5	Laurens........	Va. Car. Chem. Co.......	Charleston, S. C.
174	Carolina Tobacco Guano.....	12.90	11.55	1.33	7.66	2.56	10.22	2.31	2.81	3.41	18.27	8.00	3.00	3.00	16.60	Jan. 25	Darlington....	Va. Car. Chem. Co.......	Charleston, S. C.
18	Chicora Amm. Super P........	11.58	12.26	2.52	4.70	5.04	9.74	1.93	2.35	2.00	15.47	8.50	2.00	2.00	13.60	Oct. 24	Laurens	Va. Car. Chem. Co.......	Charleston, S. C.
160	Chicora H. G. Fertilizer......	16.08	10.82	1.47	6.96	2.39	9.35	2.63	3.19	1.73	17.01	8.00	2.50	1.00	13.55	Jan. 22	Mullins........	Va. Car. Chem. Co.......	Charleston, S. C.
228	Chicora Tobacco Guano. ...	12.65	11.00	2.67	5.94	2.39	8.33	2.72	3.30	2.50	17.16	8.00	3.00	3.00	16.60	Feb. 7	Silver Street..	Va. Car. Chem. Co.......	Charleston, S. C.
55	Cherokee H. G. Amm. Fert...	14.71	11.67	1.66	4.12	5.89	10.01	2.10	2.55	1.07	15.35	8.00	2.50	1.00	13.55	Jan. 8	Anderson......	Va. Car. Chem. Co	Charleston, S. C.
205	Columbia Soluble Guano......	14.24	11.62	1.88	5.99	3.75	9.74	1.80	2.19	2.03	15.09	8.50	2.00	2.00	13.60	Jan. 29	Seneca.........	Columbia Guano Co.... .	Norfolk, Va.
151	Clarendon Tobacco Guano....	14.07	11.05	0.81	8.16	2.08	10.24	2.34	2.84	3.11	18.09	8.00	3.00	3.00	16.60	Jan. 21	Darlington....	Navassa Guano Co.......	Wilmington, N.C.
163	Cotton Guano...	9.24	11.42	1.67	7.20	2.55	9.75	2.21	2.69	1.49	15.87	8.00	2.50	1.00	13.55	Jan. 22	Mullins........	The W. C. Macmurphy Co.	Charleston, S. C.
176	Durham Golden Leaf T. Guano	13.83	11.07	1.47	7.60	2.00	9.60	2.48	3.01	3.07	17.97	8.00	3.00	3.00	16.60	Jan. 25	Darlington....	Va. Car. Chem. Co.......	Charleston, S. C.
133	Early Trucker................	8.92	9.67	1.54	4.96	3.17	8.13	4.24	5.15	5.27	24.12	7.00	5.00	5.00	22.60	Feb. 9	Youngs Island	Lazaretto Guano Co.....	Baltimore, Md.
119	Early Trucker................	8.57	9.72	1.45	5.25	3.02	8.27	4.41	5.35	5.02	24.51	7.00	5.00	5.00	22.60	Jan. 25	Seabrook.....	Lazaretto Guano Co.....	Baltimore, Md.
118	Edisto Amm. Dis. Bone......	14.93	12.84	2.33	6.24	4.27	10.51	1.70	2.07	1.68	15.10	8.50	2.00	2.00	13.60	Jan. 24	Allendale	Va. Car. Chem. Co.	Charleston, S. C.

TABLE I. AMMONIATED FERTILIZERS.—Continued.

Sample No.	Brand of Fertilizer	Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Soluble in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Soluble in Water	Guaranteed: Relative Com. Value per Ton	Dates Sampled	Sampled At	Manufacturer	Manufactured At
268	Edisto Ammoniated Fert.	12.18	11.40	2.51	4.06	4.83	8.89	2.47	3.00	1.45	15.92	8.00	2.50	1.00	13.55	Jan. 30	Ridgeway	Va. Chem. Car. Co.	Charleston, S. C.
230	Electric Crop Grower	9.78	10.68	1.20	6.05	3.43	9.48	1.70	2.06	2.10	14.62	8.50	2.00	2.00	13.60	Feb. 7	Pomaria	Pocomoke Guano Co.	Norfolk, Va.
117	Etiwan Amm. Diss. Bone.	11.36	12.72	3.22	6.93	2.57	9.50	1.65	2.00	2.15	14.54	9.00	2.00	2.00	14.00	Jan. 24	Fairfax	Etiwan Fert. Co.	Charleston, S. C.
38	Etiwan Bright Leaf. Tob. Gua.	11.11	11.64	2.78	6.67	2.19	8.86	2.35	2.85	3.02	16.93	8.00	3.00	3.00	16.60	Jan. 12	Marion	Va. Car. Chem. Co.	Charleston, S. C.
11	Eureka Ammoniated Bone	10.62	11.77	2.29	6.60	2.88	9.48	1.70	2.07	2.03	14.59	8.50	2.00	2.00	13.60	Oct. 9	Gaffney	Va. Car. Chem. Co.	Charleston, S. C.
85	Eutaw XX Guano.	15.76	10.49	0.91	8.05	1.53	9.58	1.69	2.05	2.22	14.79	8.50	2.00	2.00	13.60	Jan. 22	Pendleton	Ashepoo Fert. Co.	Charleston, S. C.
92	Farmers Bone Fertilizer	15.68	11.26	2.14	6.01	3.11	9.12	1.87	2.27	2.02	14.79	8.50	2.00	2.00	13.60	Jan. 24	Duncans.	F. S. Royster Guano Co.	Norfolk, Va.
270	Farmers Friend Fertillzer	14.14	10.32	.72	7.47	2.13	9.60	1.95	2.37	1.47	14.93	8.00	2.50	1.00	13.55	Feb. 1	Camden	Read Phosphate Co.	Charleston, S. C.
234	Georgia Formula	11.60	11.39	2.34	5.35	3.70	9.05	1.77	2.15	2.56	14.92	8.50	2.00	2.00	13.60	Feb. 8	Greenwood	Georgia Chem. Works.	Augusta, Ga.
124	Geogia State Grange Fert.	13.13	13.20	2.66	6.19	4.35	10.54	2.00	2.43	1.63	15.97	9.00	2.00	2.00	14.00	Jan. 29	Allendale	Va. Car. Chem. Co.	Charleston, S. C.
226	Gold Dust Guano	10.59	9.56	1.01	6.17	2.38	8.55	2.64	3.20	1.94	16.59	8.00	2.50	1.00	13.55	Feb. 6	Newberry	Newberry O.M.& Fert Co	Newberry, S. C.
79	Golden Harvest Guano	10.70	10.27	1.04	4.72	4.51	9.23	2.34	2.84	1.12	15.49	8.00	2.50	1.00	13.55	Jan. 21	Anderson	Swift Fert. Works	Atlanta, Ga.
59	Grain Fertilizer	9.40	11.09	1.11	7.16	2.82	9.98	2.57	3.12	2.53	18.06	8.00	2.00	2.00	13.20	Jan. 10	Newberry	Newberry O.M.& Fert Co	Newberry, S. C.
96	Greenville Soluble Guano	16.28	11.23	1.09	7.45	2.69	10.14	2.29	2.78	2.97	17.74	9.00	2.00	2.00	14.00	Jan. 25	Woodruff	Va. Car. Chem. Co.	Charleston, S. C.
120	High Grade Truck Guano	7.78	8.10	1.32	4.98	2.60	7.58	6.65	8.08	5.44	31.16	7.00	8.00	5.00	30.10	Jan. 25	Seabrook	Lazaretto Guano Co.	Baltimore, Md.
122	H. G. Vegetable Fert. 4-6-6	12.33	9.77	1.26	6.21	2.30	8.51	2.42	2.94	7.02	20.48	4.00	6.00	6.00	23.60	Jan. 28	Seabrook.	Va. Car. Chem. Co.	Charleston, S. C.
123	H. G. Vegetable Fert. 4-4-6	11.34	7.68	1.19	4.49	2.00	6.49	3.35	4.07	6.86	21.54	4.00	4.00	6.00	18.60	Jan. 28	Big Island	Va. Car. Chem. Co.	Charleston, S. C.
121	H. G. Vegetable Fert. 4-4-4	12.48	8.09	1.16	4.89	2.04	6.93	2.96	3.60	4.90	18.95	4.00	4.00	4.00	16.80	Jan. 28	Big Island	Va. Car. Chem. Co.	Charleston, S. C.
168	Hyco Tobacco Guano	14.88	10.87	1.60	5.56	3.71	9.27	2.27	2.76	3.28	17.27	8.00	3.00	3.00	16.60	Jan. 23	Marion	Columbia Guano Co.	Norfolk, Va.
111	Imperial Amm. Fert.	11.43	11.90	2.55	6.95	2.40	9.35	2.71	3.29	1.34	16.91	8.00	2.50	1.00	13.55	Jan. 19	Barnwell	Va. Car. Chem. Co.	Charleston, S. C.
47	Im. Bright Leaf Tob. Grower	10.20	11.03	3.07	4.91	3.05	7.96	2.60	3.16	3.32	17.26	8.00	3.00	3.00	16.60	Jan. 18	Darlington	Va. Car. Chem. Co.	Charleston, S. C.
164	Latimer's Complete Fert.	11.85	9.65	1.00	5.97	2.68	8.65	2.40	2.92	1.94	15.97	8.00	2.50	2.00	14.45	Jan. 22	Mullins	Acme Mfg. Co.	Wilmington, N.C.
9	Macmurphy's Spec'l C & C G.	11.99	9.47	.58	6.65	2.24	8.89	1.72	2.09	2.22	14.34	8.00	2.00	2.00	13.20	Oct. 9	Gaffney	The W. C. Macmurphy Co.	Charleston, S. C.
30	Monarch H. G. Guano	12.09	12.29	1.02	6.91	4.36	11.27	2.78	3.37	4.22	21.24	8.00	4.00	4.00	20.00	Nov. 6	Park Station	Swift Fert. Works	Atlanta, Ga.

TABLE I. AMMONIATED FERTILIZERS—Continued.

Sample No.	Brand of Fertilizer	Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Soluble in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Soluble in Water	Guaranteed: Relative Com. Value per Ton	Dates Sampled	Sampled At	Manufacturer	Manufactured At
152	Navassa Universal Fert.	14.21	11.23	1.75	6.92	2.56	9.48	2.05	2.46	1.73	15.29	8.00	2.50	1.00	13.55	Jan. 24	Darlington	Navassa Guano Co.	Wilmington, N.C.
202	Ober's Farmers Mixture	12.24	11.60	.84	9.80	.96	10.76	1.19	1.45	2.67	14.64	9.00	1.00	2.00	15.50	Jan. 29	Calhoun	G. Ober Sons & Co.	Baltimore, Md.
155	Orinoca Tobacco Guano	11.35	11.14	1.94	5.59	3.61	9.20	2.31	2.81	3.20	17.27	8.00	2.50	3.00	15.35	Jan. 21	Darlington	F. S. Royster Guano Co.	Norfolk, Va.
87	Owl Brand Guano	12.97	11.49	2.38	4.91	4.20	9.11	2.08	2.53	2.10	15.50	8.50	2.00	2.00	13.60	Jan. 23	Easley	Va. Car. Chem. Co.	Charleston, S. C.
107	Patapsco Guano	10.95	10.67	1.15	7.19	2.33	9.52	2.12	2.57	1.80	15.74	8.00	2.50	2.00	14.45	Jan. 15	Newtons	Ga. Chem. Works	Augusta, Ga.
61	Pilot Boy Fertilizer	7.92	11.95	2.52	7.22	2.21	9.43	3.39	4.12	2.78	20.37	9.00	3.50	2.00	17.75	Jan. 10	Newberry	NewberryOM&&Fert Co	Newbsrry, S. C.
219	Pocomoke Super. Phosphate	9.74	10.87	1.39	6.09	3.39	9.48	1.67	2.03	2.17	14.61	8.50	2.00	2.00	13.60	Feb. 4	Greenwood	Pocomoke Guano Co.	Norfolk, Va.
32	Planters Amm. Guano	9.64	10.98	.47	5.12	5.39	10.51	1.78	2.16	2.01	15.62	8.50	2.00	2.00	13.60	Nov. 6	Park Station	Swift Fert. Works	Atlanta, Ga.
132	Read's H. G. Truck Fert.	9.74	8.41	.63	5.80	1.98	7.78	4.18	5.07	5.58	23.92	7.00	5.00	5.00	22.60	Feb. 8	Young's Island	Read Phos. Co.	Charleston, S. C.
225	Red Bull Fertilizer	16.65	11.28	2.27	7.20	1.81	9.01	2.64	3.21	2.59	17.50	8.00	3.00	2.00	15.70	Feb. 7	Newberry	Va. Car. Chem. Co.	Charleston, S. C.
231	Rex Ammoniated Guano	12.02	10.80	1.13	5.21	3.86	9.67	2.08	2.53	1.14	14.61	8.00	2.50	1.00	13.55	Feb. 7	Pomaria	Columbia Guano Co.	Norfolk, Va.
213	Richmond Bone Mixture	14.72	10.99	1.00	6.27	3.72	9.99	1.72	2.09	1.52	14.61	8.00	2.00	1.00	12.30	Feb. 2	Anderson	Richmond Guano Co.	Richmond, Va.
27	Richmond Premium Fert.	9.81	12.37	1.96	5.82	4.59	10.41	1.74	2.11	1.87	15.29	8.50	2.00	2.00	13.60	Oct. 29	Campobello	Richmond Guano Co.	Richmond, Va.
100	Special H. G. Guano	11.13	12.18	.41	8.53	3.24	11.77	4.12	5.00	3.53	25.09	9.50	5.00	3.00	22.80	Jan. 26	Greenville	Swift Fert. Works	Atlanta, Ga.
162	Special Tobacco Guano	13.10	9.54	.28	7.56	1.70	9.26	2.41	2.93	3.18	17.58	8.00	3.00	3.00	16.60	Jan. 22	Mullins	W. C. Macmurphy Co.	Charleston, S. C.
260	Standard Amm. Fert.	16.27	12.42	1.68	8.07	2.67	10.74	1.27	1.54	1.06	13.40	8.00	2.50	1.00	13.55	Jan. 25	Fort Mill	Va. Car. Chem. Co.	Charleston, S. C.
114	Stono Blood Guano	16.75	11.46	1.30	7.68	2.48	10.16	1.71	2.08	2.61	15.68	8.50	2.00	2.00	13.60	Jan. 21	Cave	Va. Car. Chem. Co.	Charleston, S. C.
43	Stono Complete Fert.	17.83	11.87	2.58	6.79	2.50	9.29	1.84	2.24	1.51	14.39	8.00	2.50	1.00	13.55	Jan. 12	Marion	Va. Car. Chem. Co.	Charleston, S. C.
173	Stono Special for Tobacco	13.56	11.85	1.54	7.82	2.49	10.31	1.93	2.34	3.32	17.09	8.00	3.00	3.00	16.60	Jan. 25	Darlington	Va. Car. Chem. Co.	Charleston, S. C.
158	Traver's Capital Tob. Fert.	11.43	10.62	1.05	7.36	2.21	9.57	3.37	4.07	3.22	20.73	8.00	4.00	3.00	19.10	Jan. 22	Nichols	Va. Car. Chem. Co.	Charleston, S. C.
40	Tobacco Fert. 8-4-3	12.58	10.77	.99	7.62	2.16	9.78	2.96	3.59	2.89	19.32	8.00	4.00	3.00	19.10	Jan. 12	Marion	Va. Car. Chem. Co.	Charleston, S. C.
53	Wando Blood Guano	16.74	11.88	2.51	6.73	2.62	9.35	1.76	2.14	2.22	14.83	8.50	2.00	2.00	13.60	Jan. 8	Anderson	Va. Car. Chem. Co.	Charleston, S. C.
235	Wando Complete Fert.	10.18	12.58	2.35	4.57	5.66	10.23	2.21	2.69	1.12	15.92	8.00	2.50	1.00	13.55	Feb. 9	Donalds	Va. Car. Chem. Co.	Charleston, S. C.
44	Wilcox & Gibbes Manip. G.	13.40	10.14	.46	7.85	1.83	9.68	2.45	2.98	2.39	17.35	9.00	2.75	2.00	15.87	Jan. 12	Marion	W. C. Macmurphy Co.	Charleston, S. C.
126	Wulberns Amm. Fert.	16.9[illegible]	11.41	2.15	6.47	2.79	9.26	2.11	2.56	1.63	15.98	8.00	2.50	1.00	13.55	Jan. 31	Barnwell	Va. Car. Chem. Co.	Charleston, S. C.

TABLE II. Acid Phosphates Without Potash.

Sample No.	Brand of Fertilizer	Found: Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Soluble in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Soluble in Water	Guaranteed: Relative Com. Value per Ton	Dates Sampled	Sampled At	Manufacturer	Manufactured At
1	Acme Acid Phosphate	14.28	13.25	1.24	7.60	4.41	12.01	....	....	....	9.61	13.00	...	....	10.40	Oct. 24	Greenwood	Acme Mfg. Co.	Wilmington, N.C.
248	Anderson H. G. Dis. Bone	14.14	15.40	.84	11.59	2.97	14.56	....	....	....	11.65	13.00	...	....	10.40	Feb. 15	Anderson	Anderson Fert. Co.	Anderson, S. C.
216	Ashepoo X X Acid Phosphate	9.33	15.08	.69	10.54	3.85	14.39	....	....	....	11.51	12.00	...	....	9.60	Feb. 4	Belton	Ashepoo Fert. Co.	Charleston, S. C.
252	Ashepoo H. G. Acid Phos.	8.36	16.07	1.60	11.60	2.87	14.47	....	....	....	11.58	13.00	...	....	10.40	Jan. 23	Gaffney	" " "	" "
70	Ashley Dis. Bone	14.63	15.12	.52	11.46	3.14	14.60	....	....	....	11.68	13.00	...	....	10.40	Jan. 19	Honea Path	Va. Car. Chem. Co.	" "
78	Capital Acid Phosphate	16.03	15.54	.77	9.98	4.79	14.77	....	....	....	11.82	13.00	...	....	10.40	Jan. 21	Anderson	Swift Fert. Works	Atlanta, Ga.
14	Chattahooche Acid Phos.	14.73	15.34	1.39	4.72	9.23	13.95	....	....	....	11.16	12.00	...	....	9.60	Oct. 14	Pickens	" " "	" "
257	Charlotte Acid Phosphate	11.79	14.30	.43	9.49	4.38	13.87	....	....	....	11.10	13.00	...	....	10.40	Jan. 24	Rock Hill	Charleston Oil & Fert. Co	Charlotte, N. C.
19	Chicora Dis. Bone	8.57	15.48	3.25	1.30	10.93	12.23	....	....	....	9.78	12.00	...	....	9.60	Oct. 24	Laurens	Va. Car. Chem. Co.	Charleston, S. C.
159	Chicora Dis. Bone	15.38	14.2	.91	11.28	2.01	13.29	....	....	....	10.63	13 00	...	....	10.40	Jan. 22	Mullins	" " " "	" "
22	Columbia H. G. Dis. Bone	12.00	14.93	.91	5.56	8.46	14.02	....	....	....	11.22	13 00	...	....	10.40	Oct. 26	Cowpens	Columbia Guano Co.	Norfolk, Va.
24	Cotton Brand Dis. Bone	8.52	15.98	1.11	9.8	4.98	14 87	....	....	....	11.90	13.00	...	....	10.40	Oct. 26	Cowpen	Va. Car. Chem. Co.	Charleston, S. C.
39	Durham Dis. Bone	13.06	15.04	1.23	11.18	2.63	13.81	....	....	....	11.05	13.00	...	....	10.40	Jan. 12	Marion	" " " "	" "
166	Edisto Dis. Bone	14.37	15.02	.74	12.33	1.94	14.27	....	....	....	11.42	13.00	...	....	10.40	Jan. 23	Marion	" " " "	" "
212	Ga. State Grange Dis. Bone	12.34	14 76	2.11	9.61	2.84	12.45	....	....	....	9.96	12.00	...	....	9.60	Jan. 31	Lownd'sville	" " " "	" "
264	Ga. State Grange Dis. Bone	14 60	15 33	.74	11.67	2.92	14.59	....	....	....	11.67	13.00	...	....	10.40	Jan. 29	Winnsboro	" " " "	" "
229	Hampton Acid Phos	13 81	15.16	.73	11.53	2.90	14.43	....	....	....	11.54	13.00	...	....	10.40	Feb. 7	Pomaria	Pocomoke Guano Co.	Norfolk, Va.
163	Imperial Dis. Bone	11.98	15.47	1.01	11.8	2.66	14.46	....	....	....	11.57	13.00	...	....	10.40	Jan. 12	Columbia	Va. Car. Chem. Co.	Charleston, S. C.
8	Macmurphy's H.G.Acid Phos.	12.10	15 71	.55	12.77	2.39	15.16	....	....	....	12.13	13.00	...	....	10.40	Oct. 9	Gaffney	W.C. Macmurphy Co.	" "
49	Navassa Dis. Bone	15 07	14 52	.52	12.45	1.55	14.00	....	....	....	11.20	13.00	...	....	10.40	Jan. 18	Darlington	Navassa Guano Co.	Wilmington, N.C.
210	Peerless Acid Phos	11 85	15.79	.99	11.41	3.39	14.80	....	....	....	11.84	14.00	...	....	11.20	Jan. 30	Walhalla	Pocomoke Guano Co.	Norfolk, Va.
104	Powers, Gibbes & Co. D. Bone	11.76	15 82	.99	11.96	2.87	14.83	....	....	....	11.86	13.00	...	....	10.40	Jan. 12	Columbia	Va. Car. Chem. Co.	Charleston, S. C.
208	Premium Dis. Bone	13.19	15.12	.74	10.23	4.15	14.38	....	....	....	11.50	13.00	...	....	10.40	Jan. 29	Walhalla	Richmond Guano Co.	Richmond, Va.

TABLE II. Acid Phosphates Without Potash—Continued.

Sample No.	Brand of Fertilizer	Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Soluble in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Soluble in Water	Guaranteed: Relative Com. Value per Ton	Dates Sampled	Sampled At	Manufacturer	Manufactured At
179	Read's H. G. Acid Phos	13.05	15.04	.75	11.60	2.69	14.29	....	....	....	11.43	13.00	....	....	10.40	Jan. 28	Sumter	Read Phos. Co.	Charleston, S. C.
209	Richmond H. G. Acid Phos.	14.31	15.89	.75	11.35	3.79	15.14	....	....	....	12.11	14.00	....	....	11.20	Jan. 30	Walhalla	Richmond Guano Co.	Richmond, Va.
127	Royal Dis. Bone	14.30	14.24	1.18	8.12	4.94	13.06	....	....	....	10.45	12.60	....	....	9.60	Feb. 1	Denmark	Va. Car. Chem. Co.	Charleston, S. C.
52	Royal Dis. Bone	8.08	14.76	1.09	11.39	2.28	13.67	....	....	....	10.94	13.06	....	....	10.40	Jan. 8	Anderson	" " " "	" "
93	Royster's H. G. Dis. Bone	9.83	15.15	.61	8.80	5.74	14.54	....	....	....	11.63	13.06	....	....	10.40	Jan. 24	Duncans	F. S. Royster Guano Co.	Norfolk, Va.

TABLE III. Acid Phosphates With Potash.

Sample No.	Brand of Fertilizer	Found: Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Soluble in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Soluble in Water	Guaranteed: Relative Com. Value per Ton	Date Sampled	Sampled At	Manufacturer	Manufactured At
222	Ashepoo Potash Acid Phos.	8.93	13.41	.41	9.12	3.88	13.00	....	....	1.13	11.42	11.00	....	1.00	9.70	Feb. 5	Laurens	Ashepoo Fert. Co.	Charleston, S. C.
227	Ashley Acid Phos. with Pot.	12.84	14.07	1.56	6.78	5.73	12.51	....	....	1.43	11.50	11.00	....	1.00	9.70	Feb. 7	Silver Street	Va. Car. Chem. Co.	" "
258	Atlantic Acid Phos. with Pot.	11.6[illegible]	12.07	1.24	4.78	6.03	10.81	....	....	3.02	11.37	10.00	....	2.00	9.80	Jan. 24	Rock Hill	" " " "	" "
247	Baldwin Acid Phos. with Pot.	12.64	12.67	2.1[illegible]	2.75	7.71	10.46	....	..	2.10	10.34	10.00	....	2.00	9.80	Feb. 14	Calhoun Falls	" " " "	" "
54	Cherokee Phos. with Potash	13.40	13.16	.96	5.03	7.11	12.14	....	....	2.42	11.89	10.00	....	2.00	9.80	Jan. 8	Anderson	" " " "	" "
21	Columbia Bone Pot. Mixture	12.47	12.2[illegible]	.61	4.75	6.88	11.63	....	....	1.64	10.78	10.00	...	2.00	9.80	Oct. 26	Cowpens	Columbia Guano Co.	Norfolk, Va.
265	Comassie Acid Phos. with Pot.	9.16	13.18	.63	9.19	3.36	12.55	....	...	1.72	11.59	10.00	....	2.00	9.80	Jan. 29	Winnsboro	Ashepoo Fert. Co.	Charleston, S. C.
267	Cotton Brand A. P. with Pot.	12.71	11.27	.64	5.55	5.08	10.63	....	....	3.2[illegible]	11.47	10.00	....	2.00	9.80	Jan. 30	Blackstock	Va. Car. Chem. Co.	" "
72	Diamond Sol. Bone with Pot.	14.47	12.69	1.54	8.39	2.76	11.15	....	....	1.81	10.35	10.00	....	2.00	9.80	Jan. 19	Honea Path	Etiwan Fert. Co.	" "
84	Enoree Acid Phos.	9.93	12.91	.50	8.61	3.80	12.41	....	..	2.02	11.77	10.00	...	2.00	9.80	Jan. 22	Pendleton	Ashepoo Fert. Co.	" "
11	Etiwan Potash Bone	12.48	12.51	2.24	7.69	2.58	10.27	....	....	3.70	11.55	10.00	...	4.00	11.60	Jan. 22	Appleton	Etiwan Fert. Co.	" "
12	Eureka Acid Phos.	9.83	14.16	2.98	2.47	8.71	11.18	....	....	2.21	10.93	10.00	...	2.00	9.80	Oct. 9	Gaffney	Va. Car. Chem. Co.	" "
29	Homestead H. G. Phos. & Pot.	10.43	12.41	.92	5.17	6.32	11.49	...		4.96	13.66	10.00	....	4.00	11.60	Nov. 1	Chester	Swift Fert. Works	Atlanta, Ga.
273	Leroy Springs A. P. with Pot.	13.43	14.1	1.69	9.68	2.73	12.41	....	...	2.3[illegible]	12.02	10.00	...	2.00	9.80	Feb. 1	Lancaster	Va. Car. Chem. Co.	Charleston, S. C.
10	Macmurphy's A. P. with Pot.	12.37	11.69	1.00	4.08	6.61	10.69	....	....	2.40	10.71	10.00	....	2.00	9.80	Oct. 9	Gaffney	W. C. MacMurphy Co.	" "
64	Navassa A. Phos. with Pot.	13.70	13.05	2.94	1.27	8.86	10.11	....	...	1.33	9.29	10.00	....	2.00	9.80	Jan. 16	Greenville	Navassa Guano Co.	Wil'mgt'n, N. C.
73	Plantation Phos. and Pot.	11.85	12.77	.56	6.18	6.03	12.21	...	...	4.31	13.65	9.00	..	3.00	9.90	Jan. 19	Honea Path	Swift Fert. Works	Atlanta, Ga.
207	Richmond Bone & P. Mixture	12.07	12.96	.58	7.96	4.42	12.38	....	....	1.58	11.53	10.00	....	2.00	9.80	Jan. 29	Walhalla	Richmond Guano Co.	Richmond, Va.
41	Royal A. Phos. with Pot.	12.53	12.01	.37	9.44	2.20	11.64	....	....	4.41	13.28	10.00	...	4.00	11.60	Jan. 12	Marion	Va. Car. Chem. Co.	Charleston, S. C.
77	Royal A. Phos. with Pot.	12.65	12.50	1.42	6.73	4.35	11.08	....	....	2.74	11.15	10.00	..	2.00	9.80	Jan. 21	Anderson	" " " "	" "
106	Special 8-4 Acid Phos.	12.56	12.05	2.02	9.38	9.10	10.03	..	....	4.49	12.07	8.00	....	4.00	10.00	Jan. 14	Williston	Augusta Guano Co.	Augusta, Ga.
233	Stonewall A. Phos. with Pot.	12.97	12.14	.97	7.14	4.03	11.17	...	....	3.00	11.64	10.00	...	2.00	9.80	Feb. 8	Chappells	Va. Car. Chem. Co.	Charleston, S. C.
23	Stonewall A. Phos. with Pot.	10.60	13.45	2.33	2.57	8.55	11.12	...	...	2.16	10.84	10.00	.	2.00	9.80	Oct. 26	Cowpens	" " " "	" "
201	Stono Acid Phos.	15.83	18.09	.74	11.84	5.51	17.35	.	..	1.69	15.48	10.00	..	2.00	9.80	Jan. 28	Liberty	" " " "	" "

TABLE III. Acid Phosphate With Potash—Continued.

Sample No.	Brand of Fertilizer	Moisture	FOUND: Phosphoric Acid: Total	Insoluble	Soluble	Reverted	Available	Nitrogen	Equivalent to Ammonia	Potash Soluble in Water	Relative Com. Value per Ton	GUARANTEED: Available Phos. Acid	Ammonia	Potash Soluble in Water	Relative Com. Value per Ton	Date Sampled	Sampled At	Manufacturer	Manufactured At
128	Stono A. Phos. with Pot......	12.57	14.16	.60	8.66	4.90	13.56	....	....	1.43	12.14	11.00	...	1.00	9.70	Feb. 1	Denmark......	" " " "	" "
31	Swift's Stn'd W.G.A.P.with P	9.61	11.53	.73	3.28	7.52	10.80	....	...	2.26	10.67	10.00	....	2.00	9.80	Nov. 6	Park Station..	Swift Fert. Works......	Atlanta, Ga.
57	Swift's (10–2) St'd A.P.with P	11.8[illegible]	13.93	.83	7.07	6.03	13.10	....	....	2.29	12.54	10.00	...	2.00	9.80	Jan. 9	Greenville.....	" " "	" "
26	Tiger Brand B. & P. Mixture	10.6[illegible]	11.53	.82	6.14	4.57	10.71	...	...	2.23	10.58	10.00	....	2.00	9.80	Oct. 29	Campobello....	Spartanburt Fert. Co....	Spartanb'g, S. C.
4	Wando A. Phos. with Pot...	12.93	10.54	.58	2.00	7.96	9.96	..	....	4.32	11.86	8.00	....	4.00	10.00	Oct. 5	Honea Path....	Va. Car. Chem. Co......	Charleston, S. C.
5	Wando A. Phos. with Pot....	16.55	14.05	1.71	6.13	6.21	12.34	.	.	1.53	11.25	10.00	.	2.00	9.80	Oct. 5	Honea Path...	" " " "	" "

TABLE IV. Cotton Seed Meals.

		FOUND										GUARANTEED							
			Phosphoric Acid																
Sample No.	Manufacturer	Moisture	Total	Insoluble	Soluble	Reverted	Available	Nitrogen	Equivalent to Ammonia	Potash Sol. in Water	Relative Com. Value per Ton.	Available Phos. Acid	Ammonia	Potash Sol. in Water	Relative Com. Value per Ton.	Date Sampled	Sampled At	Manufacturer	Manufactured At
69	Abbeville Oil and Fert. Co....	7.13	2.38	.14	1.11	1.13	2.24	7.05	8.56	1.52	23.70	...	7.50	....	18.00	Jan. 19	Abbeville.........	Abbeville Oil & Fert. Co.	Abbeville, S. C.
129	Aiken Industrial Co....	8.26	2.53	.11	.91	1.48	2.39	6.51	7.90	1.47	22.20	....	...	....	.....	Feb. 2	Aiken..............	Aiken Industrial Co	Aiken, S. C.
81	Anderson Oil and Fert. Co...	6.69	2.76	.17	1.00	1.59	2.59	7.21	8.76	1.53	24.47	....	7.50	.. .	18.00	Jan. 21	Anderson	Anderson Oil & Fert. Co	Anderson, S. C.
35	Atlantic Cotton Oil Co.......	6.13	2.69	.20	1.02	1.47	2.49	6.82	8.28	1.48	23.20	1.50	7.50	1.00	20.16	Jan. 10	Sumter...	Atlantic C. Oil Co.... ..	Sumter, S. C.
181	Atlantic Cotton Oil Co.......	5.96	2.87	.18	1.22	1.45	2.67	7.11	8.63	1.67	24.35	....	7.50	....	18.00	Feb. 1	Bennettsville	" " "	Bennettsville, S.C.
271	Atlantic Cotton Oil Co.	6.23	2.70	.18	1.18	1.34	2.52	7.54	9.16	1.63	23.47	1.50	7.50	1.00	20.16	Feb. 1	Camden	" " "	Camden, S. C.
110	Bamberg Oil Mill............	6.64	2.58	.18	1.04	1.36	2.40	6.60	8.61	1.55	22.54	1.50	8.00	1.00	21.30	Jan. 18	Bamberg.....	Bamberg, C. Oil Co.....	Bamberg, S. C.
15	Coronaca Milling Co.........	7.48	2.34	.17	1.01	1.16	2.17	6.20	7.53	1.40	21.07	....	7.00	..	16.80	Oct 17	Coronaca..........	Coronaca Milling Co...	Coronaca, S. C.
238	Clinton Oil Mill	7.77	2.48	.19	1.04	1.25	2.29	7.19	8.73	1.45	24.09	...	8.00	....	19.20	Feb. 6	Clinton............	Clinton Oil Mill....	Clinton, S. C.
25	Campobello Oil Mill..........	5.96	2.52	.18	1.01	1.33	2.34	7.61	9.24	1.41	25.32	..	8.00	....	19.20	Oct. 29	Campobello.......	Campobello Oil Mill....	Campobello, S. C.
86	Easley Oil Mill..	6.88	2.55	.18	1.18	1.19	2.37	7.70	9.35	1.57	25.75	....	8.00	...	19.20	Jan. 23	Easley...........	Easley Oil Mill.........	Easley, S. C.
71	Excelsior Oil and Fert. Co...	8.39	2.58	.19	1.13	1.26	2.39	7.15	8.68	1.52	24.11	...	8.00	....	19.20	Jan. 21	Anderson.	Excelsior Oil & Fert. Co	Anderson, S. C.
266	Fairfield Oil and Fert. Co....	7.48	2.51	.14	1.22	1.15	2.37	6.61	8.02	1.54	22.53	....	7.00	...	16.80	Jan. 29	Winnsboro........	Fairfield Oil & Bert. Co.	Winnsboro, S. C.
94	Fairforest Oil Mill..	7.08	2.41	.13	1.19	1.09	2.28	7.55	9.17	1.52	25.26	....	7.00	..	16.80	Jan. 27	Fairforest.	Fairforest Oil Mill Co ..	Fairforest, S. C.
76	Farmers Oil Mill..	8.14	2.35	.18	.87	1.30	2.17	6.77	8.20	1.50	22.77	....	7.00	....	16.80	Jan. 21	Anderson.	Farmers Oil Mill........	Anderson, S. C.
68	Farmers Oil Mill...........	7.65	2.46	.13	1.16	1.17	2.33	7.62	8.52	1.49	23.65	....	8.00	....	19.20	Jan. 18	Greenwood.......	Farmers Oil Mill........	Greenwood, S. C.
37	Florence Oil Mill	7.18	2.69	.18	1.04	1.47	2.51	6.40	7.77	1.52	22.02	1.50	7.00	1.00	18.90	Jan. 11	Florence	Florence Oil Mill.......	Florence, S. C.
98	Fountain Inn Oil Mill	8.49	2.17	.17	.97	1.03	2.00	6.56	7.96	1.48	22.04	....	7.00	...	16.80	Jan. 26	Fountain Inn......	Fountain Inn C. Mill Co.	Fountain Inn, S.C.
97	Gray Court Cotton Oil Co....	7.10	2.48	.13	1.13	1.22	2.35	6.50	7.89	1.53	22.19	....	7.00	.	16.80	Jan. 26	Graycourt.....	Graycourt C. Oil Mill...	Graycourt, S. C.
90	Greers Oil and Fert. Co... ..	7.61	2.42	.19	1.11	1.12	2.23	7.82	9.50	1.55	25.98	...	7.50	....	18.00	Jan. 24	Greers...	Greers Oil & Fert. Co...	Greers, S. C.
2	Greenwood Oil Co....... ...	5.85	2.56	.19	1.11	1.27	2.37	7.26	8.82	1.74	24.63	2.00	8.60	1.00	21.70	Oct. 21	Greenwood.......	Greenwood Oil Co.	Greenwood, S. C.
223	Goldville Manufacturing Co.	4.78	2.51	.17	1.20	1.14	2.34	7.51	9.12	1.68	25.27	....	8.00	....	19.20	Oct. 7	Goldville	Goldville Mfg. Co.......	Goldville, S. C.
71	Hone Path Oil Mill	8.13	2.30	.14	1.02	1.14	2.16	6.95	8.44	1.50	23.33	....	7.50	....	18.00	Jan. 19	Honea Path.	Honea Path Oil Mill ...	Honea Path, S. C.
113	Kathwood Manufacturing Co	8.35	2.66	.17	1.24	1.27	2.51	6.87	8.32	1.53	23.35	....	8.00	....	19.20	Jan. 21	Allendale..	Kathwood Mfg. Co......	Kathwood, S. C.

TABLE IV. Cotton Seed Meals—Continued.

Sample No.	Manufacturer	Found: Moisture	Found: Phosphoric Acid: Total	Found: Phosphoric Acid: Insoluble	Found: Phosphoric Acid: Soluble	Found: Phosphoric Acid: Reverted	Found: Phosphoric Acid: Available	Found: Nitrogen	Found: Equivalent to Ammonia	Found: Potash Sol. in Water	Found: Relative Com. Value per Ton	Guaranteed: Available Phos. Acid	Guaranteed: Ammonia	Guaranteed: Potash Sol. in Water	Guaranteed: Relative Com. Value per Ton	Date Sampled.	Sampled At	Manufacturer	Manufactured At
20	Laurens Oil & Fert. Co	8.20	2.41	.24	1.09	1.68	2.17	7.19	8.73	1.54	24.07	....	8.00	....	19.20	Oct. 24	Laurens.......	Laurens Oil & Fert. Co	Laurens, S. C.
13	Liberty Oil M. & Mfg Co	6.45	2.78	.23	1.04	1.71	2.75	7.47	9.04	1.58	25.16	1.50	8.00	1.00	21.30	Oct. 13	Liberty........	Liberty O. M. & Mfg Co	Liberty, S. C.
211	Lowndesville C. O. Co	5.61	2.6	.11	1.18	1.28	2.46	6.90	8.38	1.49	23.42	....	8.00	....	19.20	Jan. 31	Lowndesville ..	Lowndesville C. O. Co.	Lowndesville, S.C.
165	Marion Oil Mill.....	6.24	[illegible]	[illegible]	1.43	1.46	2.89	7.06	8.57	1.60	24.32	....	7.00	....	16.80	Jan. 22	Marion..........	Marion Oil Mill.......	Marion, S. C.
67	McCormick C. Oil Co.	8.28	2.48	.14	1.07	1.27	2.34	7.41	9.00	1.49	24.81	....	7.50	....	18.00	Jan. 18	McCormick	McCormick C. O. Co..	McCormick, S. C.
65	Moneynick Oil Mill	7.29	2.44	.18	1.23	1.03	2.26	6.79	8.25	1.47	22.93	....	8.00	....	19.20	Jan. 17	Pelzer..........	Moneynick Oil Mill...	Pelzer, S. C.
60	Newberry Oil & F. Co.	8.13	2.48	[illegible]	.91	1.42	2.33	7.09	8.61	1.53	23.91	....	8.00	....	19.20	Jan. 19	Newberry	Newberry O. & Fert. Co	Newberry, S. C.
16	Ninety-six Oil Mill	8.73	2.3	.19	.91	1.29	2.11	6.72	8.16	1.42	22.55	....	8.00	....	19.20	Oct. 17	Ninety-Six....	Ninety-Six Oil Mill..	Ninety-Six, S. C.
171	N. C. Cotton Oil Co.	7.27	2.6	.17	1.27	1.25	2.52	6.82	8.28	1.59	23.32	....	7.50	....	18.00	Jan. 23	Marion........	N. C. Cotton Oil Co..	Wilmington, N.C.
82	Pendleton Oil & F. Co	8.24	2.62	.17	.92	1.53	2.45	7.17	8.68	1.59	24.22	....	7.50	....	18.00	Jan. 22	Pendleton.	Pendleton O. & Fert. Co	Pendleton, S. C.
1[illegible]	Planters' Cotton O. Co	6.76	2.73	.19	.96	1.38	2.34	6.93	8.42	1.62	23.04	....	7.50	....	18.00	Jan. 14	Williston	Planters C. Oil Co.....	Augusta, Ga.
7	Produce Mills	6.99	2.75	.17	.95	1.41	2.36	7.12	8.65	1.52	24.02	....	7.00	....	16.80	Oct. 8	Spartanburg ..	Produce Mills..........	Spartanburg, S. C.
7[illegible]	Saluda Oil Mill	7.77	2.49	.19	.87	1.40	2.27	7.23	8.78	1.58	24.31	....	8.00	....	19.20	Jan. 17	Piedmont	Saluda Oil Mill........	Piedmont, S. C.
20[illegible]	Seneca Oil Mill	9.07	2.39	.19	1.10	1.09	2.11	6.88	8.37	1.53	23.11	....	7.50	....	18.00	Jan. 29	Seneca....	Seneca Oil Mill..	Seneca, S. C.
9	Simpsonville Oil Mill	8.12	2.23	.10	1.18	.97	2.13	6.79	8.25	1.73	22.88	....	7.00	....	16.80	Jan. 26	Simpsonville ..	Simpsonville O. M. Co.	Simpsonville, S. C.
101	Southern Cot. Oil Co.	7.06	2.46	.18	1.06	1.22	2.28	6.70	8.14	1.52	22.73	1.50	7.00	1.00	18.90	Jan. 12	Columbia.....	Southern C. Oil Co....	Columbia, S. C.
11[illegible]	Southern Cot. Oil Co.	6.73	2.33	.14	1.20	.99	2.19	5.91	7.18	1.47	20.31	1.50	7.00	1.00	18.9	Jan. 21	Allendale.. ..	Southern C. Oil Co....	Barnwell, S. C.
13[illegible]	Southern Cot. Oil Co.	7.73	2.53	.17	1.15	1.21	2.36	6.95	8.44	1.51	23.50	....	....	....	....	Feb. 9	Young's Island	Southern C. Oil Co. .	Savannah, Ga.
5[illegible]	S. C. Cotton Oil Co..	6.93	2.49	.14	.99	1.36	2.35	6.99	8.49	1.47	23.58	....	7.50	....	18.00	Jan. 10	Greenville.....	S. C. Cotton Oil Co...	Greenville, S. C.
10[illegible]	S. C. Cotton Oil Co..	7.81	2.49	.19	1.04	1.26	2.30	6.74	8.18	1.58	22.84	1.50	7.00	1.00	18.90	Jan. 12	Columbia......	S. C. Cotton Oil Co....	Columbia. S. C.
[illegible]1	Tiger Shoals Mill. Co.	8.18	2.35	.17	1.14	1.04	2.18	7.51	9.12	1.46	24.95	....	8.00	....	19.20	Jan. 24	Tiger Shoals	Tiger Shoals M. Co...	Duncans, S. C.
66	Williamston O & F Co.	7.87	2.48	.18	1.04	1.26	2.30	7.21	8.76	1.56	24.27	....	8.00	....	19.20	Jan. 17	Williamston...	Williamston O. & F. Co.	Williamston, S. C.
9[illegible]	Woodruff Cot. Oil Co.	8.40	2.55	.14	1.00	1.41	2.41	6.8	8.37	1.44	23.31	....	7.50	....	18.00	Jan. 27	Woodruff......	Woodruff C. Oil Co....	Woodruff, S. C.

TABLE V. Kainits.

Sample No.	Importer or Dealer.	Found. Potash Sol. in Water.	Found. Relative Com. Value per ton	Guaranteed Potash Sol. in Water.	Guaranteed Relative Com. Value per ton	Date Sampled.	Sampled at	Importer or Dealer.	Address.
263	Ashepoo Fertilizer Co.	12.56	11.30	12.00	10.80	Jan. 29	Winnsborro, S. C.	Ashepoo Fertilizer Co.	Charieston, S. C.
62	Atlantic C. Oil Co.	12.14	10.93	12.00	10.80	Jan. 10	Newberry, S. C.	Atlantic Cotton Oil Co.	Sumter, S. C.
239	Columbia Guano Co	12.43	11.19	12.00	10.80	Feb. 12	Troy, S. C.	Columbia Guano Co.	Norfolk, Va.
109	Etiwan Fertilizer Co.	11.58	10.42	12.00	10.80	Jan. 17	Blackville, S. C.	Etiwan Fertilizer Co.	Charleston, S. C.
50	Navassa Guano Co	12.28	11.05	12.00	10.80	Jan. 18	Darlington, S. C.	Navassa Guano Co.	Wilmington, N. C.
237	Swift's Fertilizer Co.	12.88	11.59	12.00	10.80	Feb. 9	Hodges, S. C.	Swift Fertilizer Works.	Atlanta, Ga.
154	Virginia-Carolina Chemical Co.	12.95	11.66	12.00	10.80	Jan. 21	Darlington, S. C.	Va.-Car. Chemical Co.	Charleston, S. C.

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South Carolina

Agricultural Experiment Station

OF

Clemson Agricultural College.

Corn.

By J. S. NEWMAN.

CLEMSON COLLEGE, S. C.

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1903.

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EXPERIMENTS IN CORN CULTURE.

(J. S. NEWMAN.)

So numerous are the inquiries for bulletins on "Corn Culture," that it has been decided to preface the report of the experiments in this bulletin with a concise discussion of the most approved methods of the preparation of the soil for and the cultivation of this important food crop.

Preparation of the Soil.—Since corn is a quick-growing crop, requiring only 100 to 120 days from seed-planting to maturity, the importance of thorough preparation of the seed-bed and rapid cultivation of the soil during the early growth of the plant, is apparent. The most serious obstacle to successful corn culture, in this latitude, is the occurrence of severe drouths during the most critical period of the development of the plant. It is, therefore, necessary to deeply and thoroughly prepare the soil, before planting, to enable it to store the maximum amount of capillary moisture and to cultivate, during growth, in such manner as will prevent wasteful evaporation and conserve the moisture for the use of the plant during the exhausting process of reproduction. Every tiller of the soil should keep constantly in view the fact that *no soil can be eminently productive without a liberal supply of humus.* Another thought, that should be ever present, is that the objects of thorough preparation of the seed-bed are: (a) To deepen the soil to increase its storage capacity for moisture and increase the pasturage area for the roots of the plant. (b) To reduce the size of the soil particles to expose the maximum surface to the influence of the oxygen of the air and other agencies for increasing the availability of the soil constituents. (c) To supply conditions favorable to the germination of seed and the penetration of the roots of plants. (d) Incidentally to destroy all foreign vegetation.

The prime object of cultivation should be to *preserve a surface soil mulch to prevent the escape of moisture except through the growing plants.* If this is properly done, the

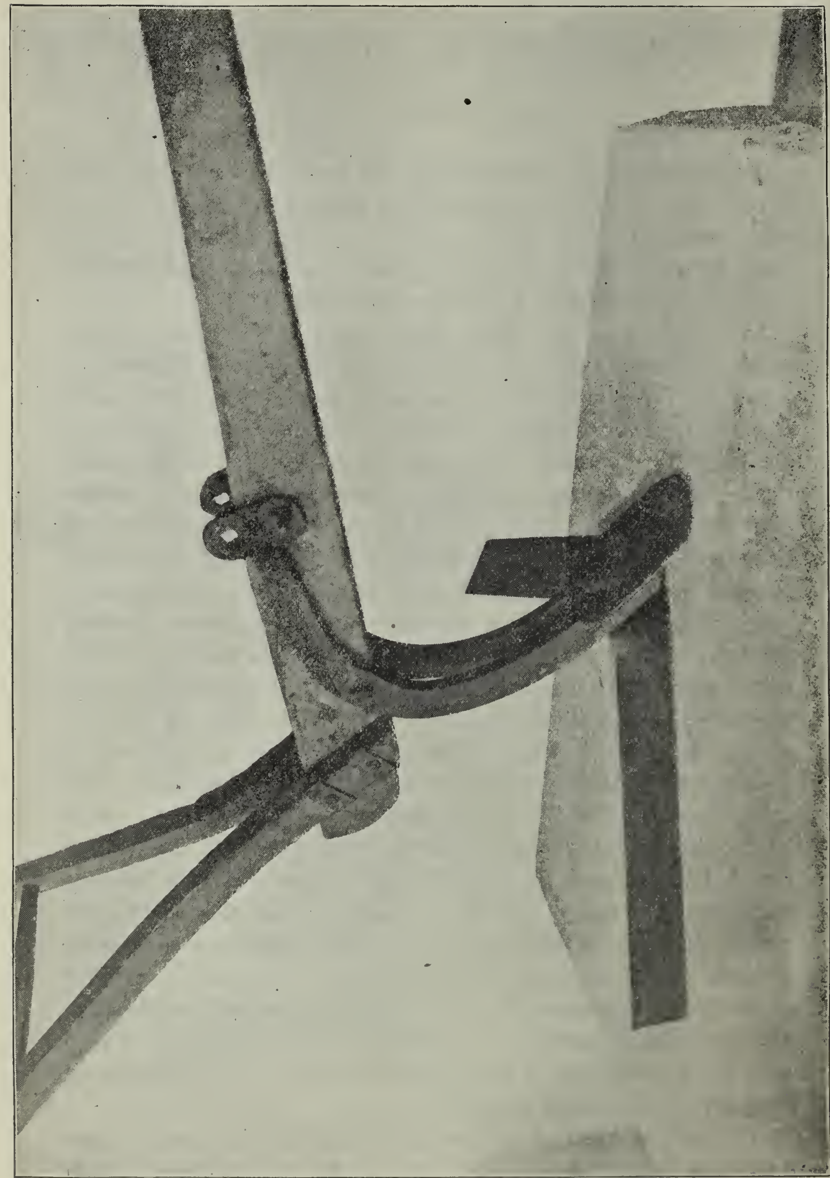

PLATE II.—Side view of Heel Scrape ready for work.

destruction of grass and weeds will follow as an incident to the primary object.

"Thorough preparation is half the cultivation." The time and manner of securing this will vary with the character, condition and previous treatment of the land, but should be thorough and appropriate. The only means by which the margin for profit in crop-production may be widened must consist in reducing the cost of production and increasing the yield per acre.

These ends may be attained: (a) By thorough preparation before planting. (b) Intelligent application of needed plant food. (c) Cultivating without mutilation of the roots and reducing *manual* labor to a minimum by means of shallow cultivation with implements which cultivate the spaces between the rows with one or two furrows. There are three methods of preparation and planting in common practice: (a) On a bed. (b) In the water furrows. (c) In shovel furrow after level preparation. The only condition under which planting on a bed is admissible is upon land that needs drainage. On such lands the beds are thrown up to secure partial drainage. Planting the water furrow is practiced upon lands which are liable to become too dry in summer for successful growth of the plants. The principal objection to this method is the removal of the surface soil from the furrow into which the seed are deposited, causing the plant to grow feebly until its roots reach out into the middles of the rows for food.

The most approved method upon all lands except wet bottoms is as follows: Prepare the land thoroughly by broadcast plowing and harrowing; open deep and wide furrows at proper intervals, giving greater distance between the rows on thin lands and less upon fertile soils.

Upon thin uplands the rows should be five feet apart and the plants three feet apart in the drill.

Corn is often planted too thickly upon thirsty uplands and frequently not thick enough upon very fertile, moist bottoms.

By this method, the seed deposited in the bottom of a shovel furrow are nearly as much below the general surface as when planted in the water furrow, while it is free from the most serious objections to the latter plan.

If the fertilizers are applied in the drill they may be either dropped between the hills of corn or distributed continuously in the furrow and mixed with the soil, to prevent injury to the germ of the seed.

The seed are covered by a single furrow run on the same side of the row throughout the field. By this method the water cannot stand over the seed in slight depressions in the row as when covered with a "double foot." The plants come through the side of the furrow and not from the bottom. The young plants are thus not so liable to be covered by the first cultivating furrow, which should be run on the same side with the covering furrow.

The first two furrows, one on each side of the row of corn, only partially fill the trench in which the young plants stand, but move enough soil around the plant to cover the young grass, thus dispensing entirely with the use of the hoe. Some use the hoe in thinning the plants. This is objectionable on account of the injury done to the roots of the plants which are left. Thinning should be done by hand while the soil is sufficiently moist to enable the surplus plants to be easily removed. This should be done before cultivation commences.

The Terrell heel scrape (Plates 1 and 2) is the most effective implement in the hands of the ordinary laborer. For cultivating rows four feet wide the scrape should measure twenty-six inches across the span of the wings. If the rows are five feet wide a thirty-inch scrape is better. In either case two furrows cover the entire row, lapping the soil slightly in the centre and amongst the plants. When properly adjusted, if placed upon a level surface, the front edge of the wings of the scrape and the point of the scooter will touch the surface. When in use the handles of the stock should be firmly pressed downward so as to cause the wings to cut uniformly throughout their entire length.

The first cultivation, with two furrows to the row, cleans the entire surface, leaving the furrow in which the corn grows only half filled. The second two furrows in the cultivation fill the depression in the drill and again stir the whole surface, leaving a *mulch of loose soil,* which prevents the loss of moisture by evaporation.

Peas may be sown broadcast before the third cultivation and covered with the scrape. Under ordinary circumstances this will complete the cultivation. The crop has received six furrows to the row—the number often used in the old deep culture, root-pruning method at the first cultivation.

When the seed germinates, a set of roots put forth. These are usually a foot long by the time the young plant unfolds its first leaf. By the time the plants are large enough to be plowed, the roots are four feet long. This was found to be the case when the roots of a plant eight inches high to the top of the last bud leaf were washed up.

At each node or joint formed by the growing plant a new set of roots is put forth. This continues even with the nodes above ground. This fact justifies the common practice of planting below the surface and adding soil as the plant grows.

No fixed rule can be given as to the number of times the crop should be cultivated. The surface should be stirred as often as may be necessary to prevent the formation of a crust and to substitute for it the *soil mulch.*

Cultivation should be discontinued when the plants bunch for tasseling.

The cultivation should be shallow—not deeper than two inches—and the surface should be level when it is completed.

Of course there are conditions under which this practice may be varied, but forty years of experience and experiment have convinced the writer that under ordinary circumstances, with average seasons in the Cotton States, the above described method produces most satisfactory results. Plates I., II. and III. illustrate the Terrell heel scrape, which costs only $1.50. There are several more costly implements adapted to level lands and large areas, but for the small farmer nothing equals the scrape.

Hay has been scarce and high during the past winter—it sells here at $20.00 per ton at the barn. If the corn stalks were saved, mascerated, and the grain ground and sprinkled over the prepared stalks, stock could be fed very cheaply.

The experiments, the results of which are recorded in Groups I., II., III. and IV., were conducted upon alluvial river bottom, which was reclaimed from Bermuda grass and underdrained in 1892. Its productiveness was increased by tillage

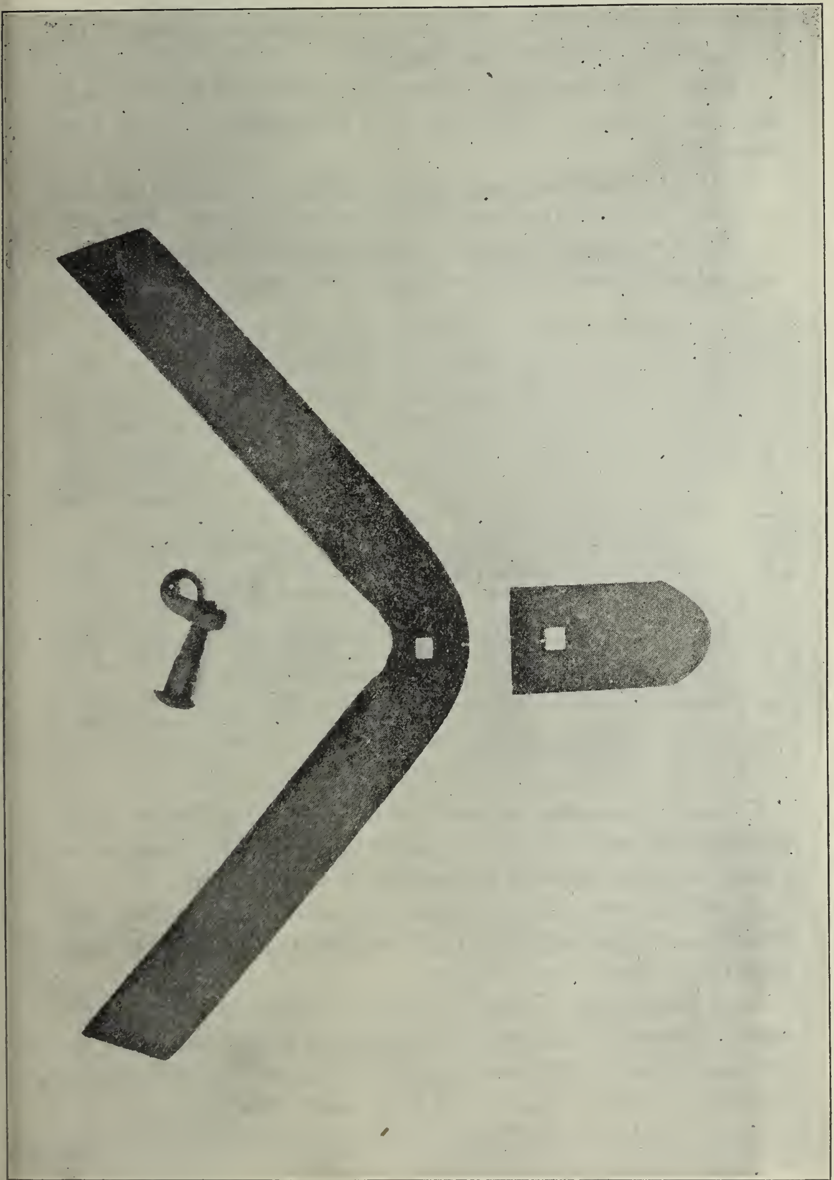

PLATE III.—Terrell Heel Scrape, short scooter and heel pin detached from the stock.

and peas from 25 bushels per acre in 1892 to the yields here reported in '98 and '99. The peas were sown broadcast in the corn and the vines left upon the land.

Owing to the moisture and fertility of the soil the effects of different methods of planting and cultivating are not pronounced.

In all plots of this group (No. I.) the rows were four feet wide and single stalks one foot apart in the drill. The only difference between the plots consisted in the method of planting and cultivating. No fertilizers were used:

EXPERIMENTS WITH CORN ON RIVER BOTTOM.

Group I.—Methods of Planting and Cultivation.

Plot No.		Yield.	
		1898 Bu. per Acre.	1899 Bu. per Acre.
1.	Planted in open furrow, cultivated shallow with heel scrape	61.7	72.4
2.	Planted on bed, cultivated shallow with heel scrape	61.1	65.5
3.	Planted in water furrow, cultivated shallow with heel scrape	57.0	66.0
4.	Planted on level ground, cultivated level and shallow with heel scrape	58.6	67.3
5.	Planted on level and cultivated in ridges with heel scrape..	60.0	72.6
6.	Planted in furrow and cultivated shallow throughout......	57.3	70.1
7.	Planted in furrow and cultivated deep throughout	51.2	66.9
8.	Planted in furrow and cultivated deep first time after cultivation shallow	61.3	72.0
9.	Planted in furrow and cultivated shallow first time, afterwards deep........	58.0	68.3
10.	Planted on level without cultivation, except cutting grass and weeds with hoe	56.5	67.5

Group II., intended to ascertain the proper number of stalks per acre and the best distribution of these, presents some interesting contrasts as well as instructive coincidences.

It will be observed that upon rich alluvial bottom the best results were obtained from plots on which the stalks had each four to six square feet of space.

It is interesting to note the increased yield of corn as the effect of planting peas in drills between the corn rows over the adjoining plot, where none were planted, and the still greater increase on Plot 4, where they were sown broadcast.

EXPERIMENTS WITH CORN ON RIVER BOTTOM.

Group II.—Planted with Different Distances.

Plot No.		Yield.	
		1898 Bu. per Acre.	1899 Bu. per Acre.
1.	Rows 3 feet apart, hills 1 foot in drill	61.0	68.2
2.	Rows 4 feet apart, hills 1 foot in drill	58.0	66.8
3.	Rows 4 feet apart, hills 1 foot in drill, peas sown in drills between the rows	60.0	69.9
4.	Rows 4 feet apart, hills 1 foot in drill, peas sown broadcast	64.0	73.2
5.	Rows 5 feet apart, hills 1 foot. (All above plots contained 1 stalk to hill)	52.8	68.0
6.	Rows 6 feet apart, hills 1 foot, 1 stalk to the hill	46.8	63.7
7.	Rows 3 feet apart, hills 2 feet, one stalk to the hill	46.8	81.1
8.	Rows 4 feet apart, hills 2 feet, one stalk to the hill	40.0	64.5
9.	Rows 4 feet apart, hills 2 feet, two stalks to the hill	54.0	75.8
10.	Rows 5 feet apart, hills 2 feet, two stalks to the hill	48.0	70.2
11.	Rows 4 feet apart, hills 3 feet, two stalks to the hill	48.0	64.2
12.	Rows 5 feet apart, hills 3 feet, two stalks to the hill	33.6	60.9
13.	Rows 4 feet apart, hills 4 feet, two stalks to the hill	38.0	61.7
14.	Rows 5 feet apart, hills 4 feet, two stalks to the hill	31.5	53.1
15.	Rows 6 feet apart, hills 2 feet, two stalks to the hill	35.8	52.8
16.	Rows 8 feet apart, hills 1 foot, four stalks to the hill	44.0	

An examination of the results as shown in Group III. discovers the fact that fertilizers in no case increased the yield of corn enough to pay for the cost of the application. It will be further observed that doubling the applications did not increase the average yield. The indications, therefore, of the results of two years are that it is not profitable to apply commercial fertilizers to that particular soil.

EXPERIMENTS WITH CORN ON RIVER BOTTOM.

Group III.—With Different Fertilizers.

Plot No.		Yield.	
		1898 Bu. per Acre.	1899 Bu. per Acre.
1.	80 lbs. Nitrate of Soda	54.8	73.7
2.	200 lbs. Kainit	61.0	69.2
3.	350 lbs. Acid Phosphate	59.1	74.7
4.	350 lbs. Acid Phisphate; 200 lbs. Kainit	58.7	73.4
5.	350 lbs. Acid Phosphate; 80 lbs. Nitrate Soda	53.2	73.9
6.	200 lbs. Kainit; 80 lbs. Nitrate of Soda	57.7	74.8
7.	200 lbs. Kainit; 350 lbs. Acid Phosphate; 80 lbs. Nitrate of Soda	62.4	73.8
8.	Nothing	57.2	67.4
9.	160 lbs. Nitrate of Soda	57.2	71.9
10.	400 lbs. Kainit	60.9	69.4
11.	700 lbs. Acid Phosphate	60.3	73.9
12.	700 lbs. Acid Phosphate; 400 lbs. Kainit	63.2	72.5
13.	700 lbs. Acid Phosphate; 160 lbs. Nitrate of Soda	61.8	77.6
14.	400 lbs. Kainit; 160 lbs. Nitrate of Soda	54.9	65.4
15.	400 lbs. Kainit; 700 lbs. Acid Phosphate; 160 lbs. Nitrate of Soda	61.7	70.6

1899.

Group IV.—Experiment with Varieties of Corn in Bottom Land.

No.		Weight in Shuck	Wt. of Shucked Corn	Per Ct. of Grain	Bushels per Acre	No. Ears per Bus.
1.	Native seed (Boggs corn)	6,395.8	5,035.1	78.3	70.5	77
2.	Albemarle Prolific	5,928.8	4,595.9	78.6	59.8	141
3.	Whitmire's (Mountain Seed Corn)	5,518.5	4,178.7	76.5	57.0	72
4.	Hicklin	5,013.2	3,688.0	84.9	55.9	101
5.	Garricks	5,382.6	4,069.5	77.8	56.5	93

The stand was not absolutely uniform on these plots, but the results are given because the difference seemed to be due, in part, at least, to variations in the vitality of the seed.

COMPARISON OF VARIETIES OF CORN ON THIN UPLAND—1900.

Plot No.		Per Cent. of Shelled	Bushels Per Acre
1.	Yellow Flint Corn	83.6	21.2
2.	Mosby's Prolific	85.1	21.4
3.	Garrick's Improved	80.0	27.4
4.	Sanders' Improved	85.1	24.2
5.	Boggs'—home grown	84.1	23.2
6.	J. E. Lewis' Prolific	84.2	25.1
7.	Albemarle Prolific	79.1	29.1

The most conspicuous fact in these results is that the variety which produced the largest quantity of shelled corn shows the smallest per cent. of shelled corn on the weight in the ear.

J. S. NEWMAN.

62 BULLETIN 62 MAY, 1901.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A &. M. COLLEGE.)

Capons and Caponizing.

O. M. WATSON.

Address all Communications to
S. C. EXPERIMENT STATION, Clemson College, S. C.
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Capons and Caponizing.

By Oscar M. Watson.

Introduction.

Although the practice of caponizing has existed in France, China and other foreign countries for more than a century, very little seems to be known or understood about it in the United States. Especially is this true in the South. We have met quite a number of intelligent people, who supposed a capon to belong to a distinct class or breed of fowls, as Wyandottes, Plymouth Rock, etc. It may be well to explain in the beginning, that a capon is a male bird with the reproductive or generative organs removed. The capon bears the same relation to other males, as to the ox to the bull, and may be made from any breed of fowls.

Advantages of Capons.

Profit.

The foremost thought of our people to-day is profit, or how much, or what can be obtained from an undertaking. We shall undertake to show how and why capons are profitable. In any market, where capons are known, they bring from 4 to 6 cents per. pound more than ordinary poultry. At the same time they grow much faster and become much larger in a given length of time than the male; just as the ox increases in size over the bull. The usual gain over the male in 8 months is from 2 to 4 pounds. In 12 months from 4 to 5 pounds. This is where the large breeds are used. The average male at 8 months old will weigh 6 pounds and bring on our markets about 7 cents per. pound. A capon of the same age will weigh 8 pounds and to say the least will bring 11 cents.

	Weight.	Price Per Pound.	Total Price.
Male eight months old	6 lbs.	7 Cents	42 Cents
Capons eight months old	8 lbs.	11 Cents	88 Cents

We see that we have over 100 % profit from the capon in 8 months. This increase of price is easily obtained in any market where capons are known. Since so many Northerners winter in our Southern towns our markets demand luxuries and they are willing to pay good prices.

We quote the following from the Philadelphia Market Report of March 20, 1901:

"Dressed stock—Fowls, 9 to 10 cents; old roosters, 7 cents; capons, 13 to 14 cents; slips, 11 to 12 cents." (Slips are males partially caponized.)

In that report we see a gain of 4 cents per pound on

slips over ordinary poultry. The reason for this advanced price is the large quantity of breast and the better quality throughout. The texture and flavor of the meat, of the capon, far surpass the quality of the ordinary fowl.

If we do not care to put our capons on the market we have much better meat for our home use and more of it.

Another Use for Capons.

Besides furnishing an abundance of excellent food, capons are very useful in taking care of broods of young chickens. They take them without any trouble, and care for them just as well, and we think better, than a hen. We have now three capons with broods of twenty chicks each.

(See Illustration on page 7.)

They are always glad to take the chicks, as neither the hens nor roosters have anything to do with them and they like company. They will scratch for them and feed them in the day time and hover them at night, and take as good care of them as a hen, and will carry them as long as the chickens will stay with them. As soon as the chickens are large enough they can taken away and another brood given to the capon. Capons never molt as do other fowls and their plumage becomes very long.

Owing to their large size and long plumage they can carry a much larger brood than a hen. They are especially valuable for taking care of chickens hatched by artificial means. The great trouble connected with artificial incubation has been in raising the chickens after they are hatched. It is not only a great deal less trouble to have capons carry the chick, but a much larger per. cent can be raised.

We avoid the crowding that we have in brooders and the heat being natural, is, of course, just what we need. If you do not use an incubator they are very serviceable in taking the first chicks hatched in the spring. You can give the chicks to a capon and either re-set the hen, or put her to laying again.

(See Illustration on page 11,)

Best Breeds for Capons.

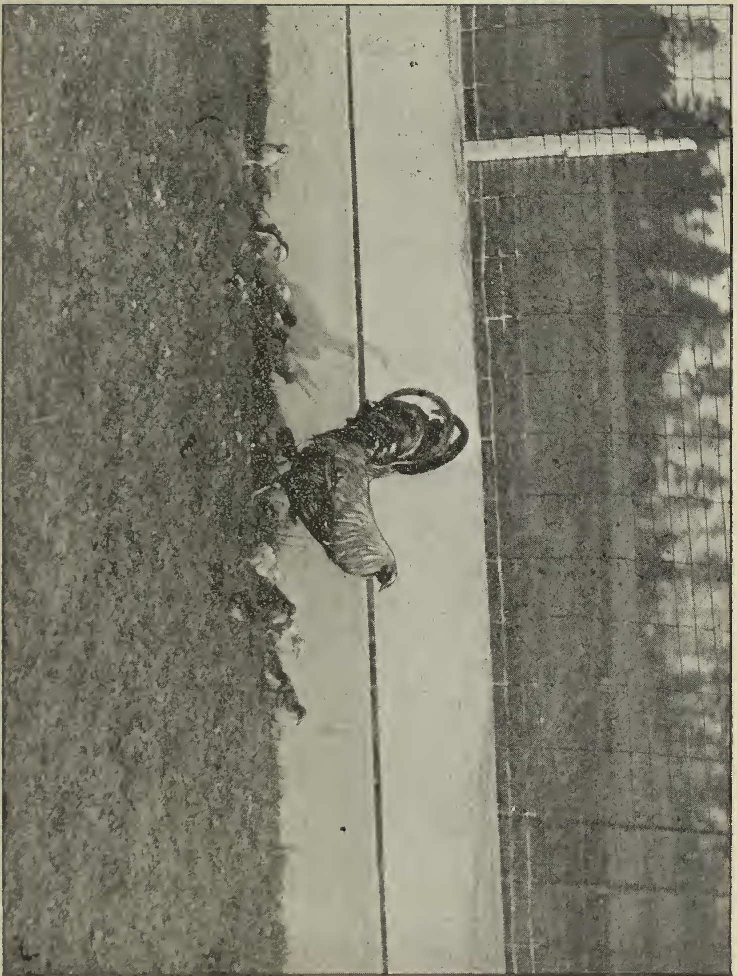
When meat alone is desired the large breeds, as Brahma, Cochin, Langshang, etc., are best, but for carrying chicks we would advise the use of the smaller and more industrious breeds, as Leghorn, Game, etc. The Plymouth Rock, Dorking and Wyandotte fill the middle ground and are useful for either purpose.

Best Age to Caponize.

The best age to caponize is when the chicks are from three to five months old. The generative organs are smaller and more easily removed, and there is much less danger from bleeding.

Preparing for the Operation.

The birds intended for the operation should have neither food nor water for at least 36 hours before hand. Experiments have shown this method to insure the best chances of success, by causing the bowels to be empty and lessening the tendency to bleeding.



Operation.

Instruments.

The following are the instruments used in caponizing: A caponizing knife, a pair of separators, a pair of pincers, a scoop spoon and a small hook. The knife and pincers are usually combined in one, and the scoop spoon and hook are usually combined in one. There are several manufacturers of caponizing sets. They cost from $2.00 to $5.00 according to quality. A set that will answer every purpose can be obtained for $2.50. Full directions accompany each set, but I shall give a general idea as to how the operation is performed. We use Wigmore's set and shall quote from his directions.

Operation.

"First have a narrow table, box or barrel so you can move it around and get the sun on the fowl in any position you wish, as the sun is a great help to the beginner. Lay the fowl upon its left side. Wrap a cord twice around the bird's legs above the knees. Wrap another cord around his wings, draw-them together on his back. To the opposite ends of the cords attach half a brick or weight of some kind and let these hang over the side of the box. By tnis means you have him secure. Wet the bird's side with cold water to prevent bleeding. This will also (we advise an antiseptic in the water) make the feathers stay where you want them. Pull the flesh on the side down towards the hip so that when the operation is over the hole between the ribs will be entirely closed by the skin going back to its place. The incision must be made between the first and second ribs about one-half inch long. When you

are ready to cut push the point of the knife in quickly one quarter of an inch, and hold it there a second, as he will work his ribs up and down just at that moment. When he becomes quiet, increase the cut to one-half an inch. Lay the knife down, keeping the skin in place with the left hand.

Take the spreader between the thumb and first finger, press it until the two ends come together. Then insert the hooked ends into the incision, making sure to have the hooks between the ribs. Hold the spreader in position with the left hand. Increase the opening by cutting toward the back bone, and forward on a line between the ribs, until it is large enough to admit the free passage of the scoop spoon. Care must be taken not to cut too near the back bone. Should he bleed much, wipe out the blood with a small sponge before you tear open the thin skin. With the hook tear open the thin skin until you have the right testicle well in view, and large enough to press the scoop spoon through. This hook must be used with care or you may puncture an artery or the bowels. Push the bowels toward the breast if they are in the way with the flat end of a tea spoon; catch the lower or left testicle in the scoop. Shake it gently to get it all in and make the spermatic cord settle well down in the slot. Then twist the testicle off. Now remove the right or upper testicle." If you cut an artery in the operation the bird is as good for food as if he had been bled in the neck. It is usually best to experiment on one or two dead birds to get the exact location of the parts.

After operating on a few birds anyone can perform it successfully

Note. Advertisements of caponizing sets can be found in almost any farm or poultry magazine.

.63

BULLETIN 63. JUNE, 1901.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

SWEET POTATO.

I. Effect of different forms of potash upon the starch content.
II. Changes in composition on storing
III. Relative Value of Different Methods of Storing.

F. S. SHIVER.

Address all communications to

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Sweet Potato.

(F. S. SHIVER.)

The object of the work undertaken in this bulletin, as its title suggests, was to ascertain, first, the effect of fertilizing with different forms of potash on the starch content of the sweet potato; secondly, and more especially, the effect of storing upon the composition of the same and lastly, then, to ascertain the relative value of several generally used methods of storing the same. All of these points are matters of the greatest importance if the sweet potato is to be used for the manufacture of starch on a commercial scale, as suggested in Bulletin 28 of this Station.

I.

We will take up for consideration, first, the experiments made to ascertain the effect of fertilizing with different forms of potash upon the starch content of the potato. It is generally believed that in so far as the "Irish," or white, potato is concerned, the effect of fertilizing with muriate of potash is to increase the water content of the same and lower the starch content.

Chlorides, in general, are believed from recent experiments, to exert a bad influence in so far as the formation of starch is concerned in the white or Irish potato. Thinking that what has been found to be true for the Irish potato might be applicable as well to the sweet potato, it was thought desirable to undertake this particular phase of the subject along with the more important work of ascertaining the changes occurring on storing. The variety of potato used was "Horton's Yam." It would have been better to use a variety other than a "Yam," since they are mostly table varieties and contain higher percentages of sugar than potatoes of some of the other common varieties such as the Southern Queen, which we believe to be admirably adapted to the production of starch on a large scale. The tendency of the "Yams," or table varieties, to produce sugar at the expense of starch is well known. The soil on which the experiment was conducted was a sandy loam, very poor in all the essential fertilizing constituents with the possible exception of potash. The field work, which was conducted by the Agricultural Department, was carried out in duplicate on twelve plots, two of which received no fertilizer; two, compost and kainit; two, compost and muriate; two, compost and sulphate of potash; two, compost and silicate of potash,

and two, compost alone. We will consider, now, first, the analyses of the potatoes grown on the different plots above mentioned. Table I will give this information. In the first column of the table is given the number of plot and fertilizer used, in the second and third, the percentages of water and starch in the potatoes as received and in the fourth and fifth, the percentages of dry substance and starch in the water-free material.

TABLE I.

ANALYSES OF SWEET POTATOES FERTILIZED WITH DIFFERENT FORMS OF POTASH.

Number of Plot and Fertilizer Used.	Original Material.		Water-free Material.	
	Water Per Cent.	Starch Per Cent.	Dry Substance Per Cent.	Starch Per Cent.
1. Compost and Kainit..	63.81	22.86	36.19	63.16
2. Compost and Muriate..	63.77	22.21	36.23	61.31
3. Nothing..	62.07	24.58	37.93	64.80
4. Compost and Sulphate Potash.....	64.97	21.63	35.03	61.75
5. Compost and Silicate Potash.......	65.87	20.70	34.13	60.66
6. Compost..	65.26	20.80	34.74	59.88

We see from the results given in this table that Plot 3 (unfertilized) has produced potatoes with the highest percentage of starch and Plot 6 (fertilized with compost alone) has produced those with the lowest percentage, basing our comparisons on water-free material. We find that the plot treated with kainit (1) has produced potatoes containing the highest percentage of starch of any of the fertilized plots. The muriate and sulphate plots (2 and 4) appear to have produced potatoes with about the same starch content, the difference, however, being in favor of the sulphate plot. The potatoes from the silicate of potash plot (5) seem to be low in starch content and high in water. The potatoes from Plot 6 (fertilized with compost alone) seem to be very similar in composition to those grown on Plot 5 (fertilized with silicate of potash.) Since it has been found that fertilizing with chlorides (muriates, etc.,) tends to increase the water content of the Irish or white potato and thus to decrease the percentages of dry matter and starch, it is worth our while to observe the percentages of dry matter in the table under consideration. We notice that the potatoes from the unfertilized plot (3) contain the highest percentage of dry matter. Those from plots fertilized with kainit and muriate respectively (1 and 2) are next in order. Then follow those from plots fertilized with sulphate, compost alone and silicate (4, 6 and 5). The potatoes from the plot fertilized with silicate of potash (5) are the lowest in dry matter. From these results, it appears that the use of fertilizer has resulted each time in a loss of dry matter. This loss is the least in the case of potatoes fertilized with kainit and muriate, and greatest in those

fertilized with silicate of potash. A more proper comparison of the fertilizing effect of the different forms of potash on the starch content of the sweet potato will be afforded by considering, not the percentage amount of starch in the potato, as has been just done, but the absolute amount of starch produced per acre. In order to get this information, we will make use of data secured from the Agricultural Department. Table II will give this information and we will now consider the same:

TABLE II.

YIELD OF STARCH PER ACRE FROM POTATOES FERTILIZED WITH DIFFERENT FORMS OF POTASH.

No. of Plot.	Fertilizer Used.	Potatoes Per Acre. (Pounds).	Starch Per Acre. (Pounds).
1.	Compost and Kainit	11,403	2,607
2.	Compost and Muriate	9,006	2,000
3.	Nothing	7,986	1,963
4.	Compost and Sulphate	9,576	2,071
5.	Compost and Silicate	9,744	2,017
6.	Compost alone	8,103	1,685

We see from the results given in this table that Plot 1 (fertilized with kainit) has given the largest yield of starch per acre and Plot 2 (fertilized with muriate) the smallest, leaving out of consideration, of course, Plots 3 and 6 (without fertilizer and fertilized with compost alone, respectively). Plots 4 and 5 (fertilized with sulphate and silicate, respectively,) give about the same yields of starch. In the case of the plot fertilized with kainit (1), the increase of starch over the unfertilized plot (3) amounts to 644 pounds, while in the case of the plot fertilized with muriate (2), it amounts to only 37 pounds. As has been said, practically the same results have been secured in the use of sulphate and silicate of potash (Plots 4 and 5), the increase of starch over the unfertilized plot being 108 pounds and 54 pounds, respectively. It would appear from this work in the first place that applications of phosphoric acid and nitrogen, without the use of potash, do not give profitable returns in so far as the yield of starch is concerned. This shows the necessity of potash in the manuring of the sweet potato. The sweet potato, in fact, is a great potash feeder. This is very evident when we consider the ash constituents of the potato. On page 13 (et seq.) of Bulletin 28 of this station, we find several determinations of the amounts of phosphoric acid, nitrogen and potash contained in the sweet potato of different varieties. We find recorded in this reference the fact that: "If a crop of sweet potatoes, say 200 bushels, or 12,000 pounds, is removed from the soil, then there is removed along with it from one acre of land 27.36 pounds of nitrogen, 10.2 pounds of phosphoric acid and 65.52 pounds of potash. It is evident from an inspection of the ta-

bles just presented that potash is a favored element with the sweet potato and we see it removes from the soil over twice as much potash as nitrogen and about six times as much potash as phosphoric acid."

While the sweet potato is very partial to potash fertilization, it does not seem indifferent, however, to the form in which the potash is applied, at least in so far as the formation of starch is concerned. For instance, we note from our experiments that an application of potash in the form of kainit has given the largest yield of starch (2607 pounds) and in the form of muriate, the smallest (2,000 pounds). From what has just been said, two conclusions, at least, seem inevitable, one of which is that an application of potash in the form of kainit (somewhat less so in the form of sulphate) appears to give the best yield of starch per acre and the second is that an application in the form of muriate gives the poorest, followed closely by the silicate of potash. It appears doubtful from these particular experiments whether an application of potash in the form either of the muriate or silicate would be remunerative. It will take, however, more extended experiments along this line to settle this particular point definitely. These experiments, therefore, must be received in the light of indications, rather than of definite and positive conclusions, to obtain which, would require several years of further experimentation. We believe these results, however, to be sufficiently promising to warrant their publication at this time, with the hope of taking up the subject again. We pass on next to the consideration of the second part of our work.

II.

THE EFFECT OF STORING UPON THE COMPOSITION OF THE SWEET POTATO.

As has been already pointed out, this is a very important consideration if the sweet potato is to be used for the production of starch in a commercial way. Because, if the changes which the sweet potato undergoes on storing are at all rapid in their character, then the period for converting them into starch will be necessarily limited.

It seems to have been established some time ago (Texas Station, Bulletin 36, p. 628, et seq.,) that the sweet potato undergoes comparatively rapid changes on storing. The character of the change in composition (whether the starch was converted into glucose or sucrose) seems, however, not to have been so well established in the experiments above referred to. It was in order to supplement these experiments on the character and rate of change in composition of the sweet potato on storing that this particular work was undertaken. The experiments were carried out both on samples of the same variety (Horton Yam) fertilized with different forms of potash and

with different varieties, all fertilized the same way. The methods of analysis used were the same as those given in Bulletin 30, page 4, of this station. We take up for consideration first the changes in composition on storing of the same variety (Horton Yam), fertilized with different forms of potash. It was thought desirable to see in this connection what, if any, potash salt seemed to favor the preservation of the potato in its original condition on storing. Consequently, six samples of the same variety (Horton Yam), fertilized with different forms of potash, were obtained immediately after harvesting on November 28th, 1898, and subjected to analysis. The analysis in every case included the percentages of water, starch, glucose and sucrose (cane sugar), calculated to water-free, original and air-dry material. We will now consider the percentages of these constituents in the six samples already referred to. Table III will give us this information, columns one, two and three giving the number of plot, variety of potato and fertilizer used, respectively, and columns four, five and six the percentages of water, starch, glucose and sucrose in the original, air-dry and water-free material, respectively. We will now consider the results in this table:

TABLE III.

ANALYSES OF FIRST LOT OF POTATOES FERTILIZED WITH DIFFERENT FORMS OF POTASH, NOVEMBER 28, 1898.

			Original				Air Dry				Water Free		
No. of Plot	Variety	Fertilizer	Water Per Cent.	Starch Per Cent.	Glucose Per Cent.	Sucrose Per Cent.	Water Per Cent.	Starch Per Cent.	Glucose Per Cent.	Sucrose Per Cent.	Starch Per Cent.	Glucose Per Cent.	Sucrose Per Cent.
1	Horton Yam	400 lbs. Kainit......... 1000 lbs. Compost......	63.81	22.86	0.96	5.41	7.33	58.53	2.45	13.86	63.16	2.64	14.96
2	Horton Yam	100 lbs. Muriate........ 1000 lbs. Compost......	63.77	22.21	1.20	6.10	7.52	56.70	3.05	15.56	61.31	3.30	16.83
3	Horton Yam	Nothing	62.07	24.58	1.19	5.28	7.91	59.67	2.88	12 83	64.80	3.13	13.93
4	Horton Yam	100 lbs. Sulph. Potash 1000 lbs. Compost......	64.97	21.63	1.51	5.59	7.59	57.06	3.97	14.75	61.75	4.30	15.96
5	Horton Yam	250 lbs. Silicate Potash 1000 lbs. Compost.....	65.87	20.70	1.27	6.03	7.57	56.07	3.43	16.34	60.66	3.71	17.68
6	Horton Yam	1000 lbs. Compost......	65.26	20.80	1.41	6.21	7.76	55.23	3.75	16.48	59.88	4.07	17.87

All these samples are apparently a little low in starch and a little high in sugars, judging by the results obtained previously and already reported in Bulletin 28 of this Station. This may be attributed possibly to two considerations, namely, that the samples of potatoes, the analyses of which are here reported, by oversight, stood over a few days after harvest before being sent in for analysis and also that the season of 1898 was a comparatively wet one. The average percentages of water, starch, glucose and sucrose in these six samples are as follows:

TABLE IV.

AVERAGE ANALYSIS OF FIRST LOT OF POTATOES, FERTILIZED WITH DIFFERENT FORMS OF POTASH.
(Nov. 28th, 1898.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
64.29	22.02	1.26	5.79	7.61	57.21	3.26	14.97	61.92	3.53	16.20

On comparing these results with those given in Bulletin 28 of this Station, pages 9 and 10, we will observe, as has been stated above, that the average percentage of starch in these samples is somewhat lower than that reported in the samples analyzed at that time. It will be observed further, however, that the average percentage of starch here found (22.02) is almost identical with the figures used in the publication already referred to for comparing the starch producing power of the sweet potato with that of the cereals, corn and wheat, namely, 22. From this, it appears that, with the sweet potato in anything like fair condition (soon after harvest), we are warranted in expecting on an average an amount of starch equivalent to *twenty-two per cent.* It appears that the average percentage of water (64.29) found in these samples is practically the same as that found in the samples, the analyses of which are reported in Bulletin 28 of this Station, viz: 64.42. From all of the work done on this particular part of the subject, it appears that the figures (70) usually given as expressing the water content of the sweet potato are not applicable to sweet potatoes in normal condition grown in this State, or, at least, in this particular part of the State. As the average of many determinations of water in the sweet potato in normal condition have given us an average of about 64 (sixty-four) per cent., we are led to believe that a content of 70 (seventy) per cent indicates something abnormal in the condition of the same. This, we believe, will be brought out very clearly in the following work. When we consider the average percentages of glucose and sucrose found in these samples, we find that they are considerably higher than is the case with the samples, the analyses of which are reported in Bulletin 28 of this Station. The most plausible of the two explanations already offered for this occurrence is that the increase in sugars is due exclusively to the fact that these samples, by oversight, were allowed to stand some little while after harvesting before they were sent in for analysis. The fact that the sweet potato changes rapidly in composition after harvesting seems conclusively proven by all the observations made during the course of this experiment. If the sweet

potato is at all damp when stored, the change in composition is exceedingly rapid and decay soon sets in. This change in composition is manifested by an increased percentage of sugar, more especially of sucrose (cane sugar) and a decreased percentage of starch. Of course, if the potatoes are to be used as articles of food, they lose nothing in value on storing; in fact, they may be enhanced in value by this process, since the large majority of people in the South prefer a sweet tuber to a dry, mealy one. But if they are to be used as a source of starch production, it is highly important that this change in composition should be retarded as much as possible. The second lot of potatoes for analysis were taken on March 1st, 1899, a period of about three months thus intervening between the time of the first and second analyses. The potatoes, meanwhile, had been stored in a closed house in piles, covered with dry broom straw. Determinations of water, starch, glucose and sucrose were made as usual in these samples. The samples, in so far as their general appearance was concerned, seemed to have been preserved in good condition.

Table V will give us these analyses of the second lot of potatoes, received March 1st, 1899. This table gives in the first column the number of plot on which the potatoes were grown. In the second, third and fourth the percentages of water, starch, glucose and sucrose in the original, air-dry and water-free material respectively:

TABLE V.

ANALYSES OF SECOND LOT OF POTATOES, FERTILIZED WITH DIFFERENT FORMS OF POTASH (March 1st, 1899.)

No. of Plot.	Original.				Air-dry.				Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	65.04	18.71	1.20	6.18	6.62	49.98	3.21	16.51	53.52	3.44	17.68
2.	63.81	18.42	1.23	7.35	7.69	46.98	3.13	18.75	50.89	3.39	20.31
3.	67.77	17.74	0.59	6.26	6.59	51.42	1.72	18.13	55.05	1.84	19.41
4.	62.31	20.07	0.89	8.05	6.74	49.65	2.21	19.91	53.24	2.37	21.35
5.	75.05	11.84	1.63	4.90	7.02	44.13	6.08	18.26	47.46	6.54	19.64
6.	67.02	14.83	1.11	8.97	6.96	41.85	3.13	25.30	44.98	3.36	27.19

On comparing these results with those in Table III we observe that the potatoes on Plot 4 (fertilized with sulphate of potash) have up to this time retained their starch content the best and those grown on Plot 5 (fertilized with silicate of potash) the poorest, the loss of starch in the first case (using figures obtained on the original substance) being 7 per cent., and in the second case 43 per cent. in round numbers of that originally present. We find that next to the potatoes grown on Plot 4, those grown on Plots 2 and 1 (fertilized with muriate of potash and kainit, respectively) have given the best results, the loss of starch being 17 per cent. in round numbers in the first in-

stance and 18 per cent. in the second. The potatoes grown on Plots 3 and 6 (fertilized with nothing at all and with compost, respectively,) have given about the same results, the loss of starch in the first case being 28 per cent. and in the second 29 per cent. in round numbers of that originally present. Another very interesting fact brought out in this work so far and which will be noticed more strikingly when we come in a few minutes to consider a comparison of the average results is this: The water content of the sweet potato on storing, contrary to what is generally believed, seems to slightly increase, instead of diminish. I think this conclusion is quite apparent when we consider all the work reported in these pages. We consider now the average percentages of water, starch, glucose and sucrose contained in the second lot of potatoes, fertilized with different forms of potash, the individual analyses of which have been just considered (Table V.) Table VI will give us this information, columns one, two and three giving the percentages of the constituents determined in the original, air-dry and water-free substances, respectively. We will now consider this information:

TABLE VI.

AVERAGE ANALYSES OF SECOND LOT OF POTATOES, FERTILIZED WITH DIFFERENT FORMS OF POTASH.

(March 1st, 1899.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
66.83	16.87	1.16	6.94	6.94	47.34	3.25	19.48	50.87	3.49	20.93

Comparing these results with those in Table V, we observe that the average percentage of starch in the second lot of potatoes is considerably lower than that found in the first lot, the average loss amounting to *23 per cent.* of that originally presented, basing calculations on the original substance. As a period of 92 days has elapsed since the analyses of the first potatoes were made and as the average actual loss of starch during this period was 5.15 per cent., therefore, the average actual loss of starch *per day* would be approximately *.06 per cent.* (during the period immediately succeeding harvesting). This is the average loss of starch during the period immediately succeeding harvesting. We would expect to find the average loss greater per day as the period of storing increases, but we do not find this strictly true. This seems, on first glance, as an insignificant factor, but when we come to consider the actual loss of starch that would be sustained at this rate by a large quantity of potatoes, we will be very much surprised. For instance, suppose we have

a factory of average size and a daily capacity of 7,000 bushels of potatoes. Suppose, further, that a supply of potatoes has been laid in sufficient for four weeks' continuous working (at the daily rate given above, 168,000 bushels or 10,080,000 pounds of potatoes would be required, basing our calculations on a week as consisting of six days), there would be sustained by this quantity of potatoes a loss of starch per day equivalent to 1,330.56 pounds, considering the potatoes in their original condition as containing 22 per cent. of starch. This loss, however, is not so excessively large when we consider the large amount of starch involved in working on the scale as above represented. It is also true, however, that in practice when working with the sweet potato it may not be possible to give the attention in storing which was bestowed on a small lot, such as we are considering here. It is also true, as we shall see from data to be presented later, that the condition in which the potato is stored (whether dry or damp), as well as the methods employed for storing, have a most important bearing on the rapidity of the changes in composition, which subsequently take place. Of course, as the quantity of potatoes increase, the problem is made more difficult. It is interesting now to consider where the starch goes, since it has been shown conclusively by the work just considered that it disappears fairly rapidly. We find on comparing the average percentage of glucose in the second lot of potatoes analyzed with that in the first lot, there is practically no difference in the data obtained. When we come to consider the sucrose, however, we find that the average percentage in the second lot of potatoes is considerably higher than that in the first lot. For instance, the average percentage of sucrose (cane sugar) in the lot first analyzed was 5.79, while that in the second lot analyzed was 6.94 in the original condition, respectively. That is to say, there was an average actual gain of 1.15 per cent. of sucrose, or, in other words, a gain of sucrose equivalent to 20 per cent. of that originally present. The question now is, therefore, whether this increased quantity of sucrose accounts for the diminished amount of starch. In other words, in the storing of the sweet potato, is the starch all converted into sucrose or are there other products formed? In the first place, the fact seems very clearly established that the change is not into glucose, as one might ordinarily expect, but into sucrose (cane sugar). We have seen already that there was an average loss of 5.15 per cent. of starch in the case of the potatoes of the second lot, as compared with those of the first lot. As the average percentages of glucose have remained the same, we omit them from further consideration in this particular. If the loss of starch is to be attributed solely to the formation of sucrose (cane sugar), then we should expect the following:

$$\begin{array}{ccccc} 324. & & 342. & & \\ 2\,C_6H_{10}O_5 & : & C_{12}H_{22}O_{11} & = & 5.15 : x \\ \text{(Starch)} & & \text{(Sucrose)} & & \text{(Loss of starch on storing)} \end{array}$$

In this equation it will give us the percentage of sucrose equivalent to 5.15 per cent. of starch. On showing this equation, we find X equals 5.44 per cent. That is to say, if this loss of starch (5.15 per cent.) is to be attributed solely to the formation of sucrose, we should expect an increase of 5.44 per cent. in the amount of sucrose (cane sugar) found. But we find an increase in sucrose of only 1.15 per cent. Therefore, at least in so far as these particular potatoes are concerned, the decrease in the amount of starch sustained on storing, cannot be attributed solely to the formation of sucrose or cane sugar. It is probable from what has just been said that, while the starch is converted in considerable measure into sucrose, and stored up as such as an intermediate step, yet the ultimate and most important change affecting the starch in the sweet potato on storing is that which brings about the formation of water and carbonic acid, the final products of all complete decompositions. However, before this complete change is brought about there may be formed intermediate products, other than sucrose and cane sugar, such as dextrin, etc. We consider next the analyses of the third lot of potatoes fertilized with different forms of potash and received for analysis April 17th, 1899. Table VII will give us these analyses, the first column giving the number of plot on which the potato was grown, the second, third and fourth, the percentages of water, starch, glucose and sucrose in the original, air-dry and water-free material, respectively. The potatoes grown on plots 5 and 6 were in such bad condition at this time that it was impossible to obtain proper samples for analysis. We will be obliged, therefore, to limit our comparisons here to the potatoes grown on plots 1, 2, 3 and 4, respectively

TABLE VII.

ANALYSES OF THIRD LOT OF POTATOES, FERTILIZED WITH DIFFERENT FORMS OF POTASH (April 17th, 1899.)

No. of Plot.	Original.				Air-dry.				Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	67.11	15.84	0.36	7.10	7.60	44.49	1.01	19.96	48.15	1.09	21.60
2.	66.84	14.58	0.90	7.46	7.70	40.59	2.49	20.76	43.98	2.70	22.49
3.	63.78	16.69	0.59	9.51	6.91	42.90	1.53	24.45	46.08	1.64	26.26
4.	66.61	18.43	0.90	6.57	8.09	50.73	2.49	18.10	55.20	2.71	19.69

We find fom this data that since the last time, when these potatoes were analyzed (March 1, 1899), those grown on Plots 4 and 3, fertil-

ized with sulphate of potash and nothing, respectively, have preserved their starch content the best, the loss of starch, since the time mentioned above, in the first instance being 8 per cent. and 6 per cent., respectively, in round numbers, of that originally present. From what has been said already, it follows that the potatoes grown on Plots 5 and 6 have not preserved their starch content at all, since they were all practically rotten at the time at which these analyses of the other samples were made. Next to the potatoes grown on Plots 4 and 3, those grown on 1 and 2 have given the best results, the loss of starch in the same, since the time mentioned above, being 15 per cent. and 21 per cent., respectively, in round numbers. The total loss of starch at this time (April 17th, 1899,) in the potatoes grown on the different plots, in percentages of that originally present (November 28th, 1898), is as follows:

TABLE VIII.

LOSS OF STARCH IN POTATOES AFTER A STORAGE OF 140 DAYS, EXPRESSED IN PERCENTAGES OF THAT ORIGINALLY PRESENT.

Plot 1 (Kainit)	30.7 per cent.
Plot 2 (Muriate)	34.4 per cent.
Plot 3 (Nothing)	32.1 per cent.
Plot 4 (Sulphate)	14.8 per cent.
Plot 5 (Silicate) potatoes rotten	
Plot 6 (Compost) potatoes rotten	

It would seem from this limited data that the indications are that potatoes fertilized with sulphate of potash, as their source of potash, will preserve their starch content the most satisfactorily on storage (the loss in 140 days of storage, expressed in percentage of that originally contained, being 14.8 per cent.) After the potatoes, fertilized with sulphate, it appears that those, to which potash was applied in the form of kainit, have given the next best results (the loss in starch in the period mentioned above, being 30.7 per cent. of that originally present.) The potatoes to which the potash was applied in the form of muriate (Plot 2) have given results less satisfactory than those to which no potash was applied (Plot 3), the loss of starch in percentages of that originally present during the period mentioned above, being 34.4 in the first instance and 32.1 in the second. The potatoes to which silicate of potash (Plot 5) and to which compost alone was applied (Plot 6) were both at this period almost entirely rotten, hence the effect of these fertilizing materials upon the starch preserving qualities of the potato seem very small. From this particular work, it appears that a loss of starch in the sweet potato, put up in good condition and stored for a period of twenty (20) weeks, equivalent to fifteen (15) per cent. of that originally present in the same is to be considered as a minimum and a loss equivalent to 32 (thirty-two) per cent. as an average. It will be observed from what has been said above that the starch preserving qualities of potatoes obtained with the use of potash in the form of muriate and sulphate, respectively, stand in about the same proportion as the starch pro-

ducing qualities of the same. By consulting Table II, we will observe that the largest actual yields of starch were made by potatoes fertilized with kainit and sulphate, as their source of potash, and, from what has been seen above, we observe likewise that the potatoes fertilized with these forms of potash, have sustained the smallest losses of starch on storing. We consider in the next place the average percentages of water, starch, glucose and sucrose contained in the third lot of potatoes, fertilized with different forms of potash, received April 17th, 1900, for analysis. Table IX will give us this information and we will now consider the same:

TABLE IX.

AVERAGE ANALYSES OF THIRD LOT OF POTATOES, FERTILIZED WITH DIFFERENT FORMS OF POTASH.

(April 17th, 1899.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
66.09	16.39	0.69	7.64	7.58	44.68	1.88	20.82	48.34	2.03	22.53

On comparison of these results with those in Table VI, we find that the average percentage of starch in the third lot of potatoes is lower again than that found in the second lot, the average loss being equivalent to about 3 per cent. of the starch found in the potatoes of the second lot (Table VI). A period of 47 days having elapsed since the last analyses (second lot) were made and there having occurred during this time an average actual loss of starch of 0.48 (16.87 per cent-16.39 per cent.) per cent., therefore, the average actual loss of starch *per day* would be approximately *.01 per cent.* This, taken in connection with what has been already said about the average actual loss of starch, during the period immediately succeeding harvest, which we found to be .06 per cent. per day, makes it appear plain that the changes which occur in the sweet potato on storing, take place much more rapidly during the period immediately succeeding harvest. We find here again on comparing the average glucose percentage in the third lot of potatoes with that in the second lot, that the difference between the two is about 0.47 per cent., the third lot containing this much less than the first lot (considering original material). From this I think we can conclude that the glucose content of a sweet potato, put up in good condition, does not undergo any appreciable alteration on storage. In regard to the sucrose content, however, we find that the potatoes of the third lot contain on an average a higher percentage than those of the second lot. We observe that the average percentage of sucrose given for the potatoes

of the third lot is 7.64 in the original material, while in the case of the second lot 6.94 was found. We observe here a difference of 0.70 per cent., which is equivalent to a gain of about 10 per cent. of that originally present in the second lot. Will the increased quantity of sucrose here found account for the decrease in starch observed? If the loss of starch is to be attributed solely to the formation of sucrose, then we would expect, as has been said before, a change which would be represented by the following chemical equation:

$$\underset{(\text{Starch})}{\overset{324.}{2\,C_6H_{10}O_5}} : \underset{(\text{Sucrose})}{\overset{342.}{C_{12}H_{22}O_{11}}} = \underset{\substack{(\text{Loss of starch}\\ \text{on storing})}}{0.48} : x$$

in which X will give us the percentage of sucrose equivalent to 0.48 per cent. of starch. On working out this equation, we find X equals 0.51 per cent. That is to say, that if this loss of starch (0.48 per cent.) is to be attributed to the formation of sucrose, then we should expect to find the percentage of sucrose increased by 0.51 per cent. As a matter of fact, we find that the percentage of sucrose has increased 0.7 per cent. Therefore, it would seem here that the change which the starch undergoes in the sweet potato at this period on storing, is to be accounted for by an increased formation of sucrose, or cane sugar. Taking what has been just said in connection with what has gone before, it would appear from these particular experiments that the loss of starch, which the sweet potato sustains on storing, is to be attributed very largely, but not wholly, to the increased formation of sucrose or cane sugar in the same. There may be possibly formed some other intermediate products, such as dextrin, but this has not yet been established. In order that we may comprehend at a glance the composition of the potatoes, fertilized with different forms of potash, at the different times at which they were analyzed, we will construct a table as follows. This table we will designate as X:

TABLE X.

ANALYSES OF POTATOES (FERTILIZED WITH DIFFERENT FORMS OF POTASH) AT DIFFERENT PERIODS DURING STORING.

First Lot (Nov. 28th, 1898.)

No. of Plot.	Fertilizer Used.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	(Kainit)	63.81	22.86	0.96	5.41	7.33	58.53	2.45	13.86	63.16	2.64	14.96
2.	(Muriate)	63.77	22.21	1.20	6.10	7.52	56.70	3.05	15.56	61.31	3.30	16.83
3.	(Nothing)	62.07	24.58	1.19	5.28	7.91	59.67	2.88	12.83	64.80	3.13	13.93
4.	(Sulphate)	64.97	21.63	1.51	5.59	7.59	57.06	3.97	14.75	61.75	4.30	15.96
5.	(Silicate)	65.87	20.70	1.27	6.03	7.57	56.07	3.43	16.34	60.66	3.71	17.68
6.	(Compost)	65.26	20.80	1.41	6.21	7.76	55.23	3.75	16.48	59.88	4.07	17.87

TABLE X.—Continued.

ANALYSES OF POTATOES (FERTILIZED WITH DIFFERENT FORMS OF POTASH) AT DIFFERENT PERIODS DURING STORING.

Second Lot (March 1st, 1899.)

No. of Plot.	Fertilizer Used.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	(Kainit)	65.04	18.71	1.20	6.18	6.62	49.98	3.21	16.51	53.52	3.44	17.68
2.	(Muriate)	63.81	18.42	1.23	7.35	7.69	46.92	3.13	18.75	50.89	3.39	20.31
3.	(Nothing)	67.77	17.74	0.59	6.26	6.59	51.42	1.72	18.13	55.05	1.84	19.41
4.	(Sulphate)	62.31	20.07	0.89	8.05	6.74	49.65	2.21	19.91	53.24	2.37	21.35
5.	(Silicate)	75.05	11.84	1.63	4.90	7.02	44.13	6.08	18.26	47.46	6.54	19.64
6.	(Compost)	67.02	14.83	1.11	8.97	6.96	41.85	3.13	25.30	44.98	3.36	27.19

TABLE X.—Concluded.

ANALYSES OF POTATOES (FERTILIZED WITH DIFFERENT FORMS OF POTASH) AT DIFFERENT PERIODS DURING STORING.

Third Lot (April 17th, 1899.)

No. of Plot.	Fertilizer Used.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	(Kainit)	67.11	15.84	0.36	7.10	7.60	44.49	1.01	19.96	48.15	1.09	21.60
2.	(Muriate)	66.84	14.58	0.90	7.46	7.70	40.59	2.49	20.70	43.98	20.70	22.49
3.	(Nothing)	63.78	16.69	0.59	9.51	6.91	42.90	1.53	24.45	46.08	1.64	26.26
4.	(Sulphate)	66.61	18.43	0.90	6.57	8.09	50.73	2.49	18.10	55.20	2.71	19.69
5.	*(Silicate)											
6.	*(Compost)											

*Tubers spoiled.

In considering the results in the table just presented, we see, as has been pointed out previously in considering the same results individually, that the percentages of water in these potatoes increase uniformly, as a rule, with the length of storing. This is very strikingly illustrated in the case of samples Nos. 1 and 2 in the table under consideration and also in the case of samples Nos. 5 and 6. In all cases, however, the percentages of water in the last lot of potatoes analyzed were higher than those found in the first lot. We find, therefore, that, in so far as these particular potatoes are concerned, the water content of the same on storing seems to increase, a fact which is contrary to the generally accepted ideas on the subject, namely, that the sweet potato on storing losses water. We find, moreover, that the loss of starch in all of these samples on storing is quite uniform throughout. As regards the glucose percentages, we observe that there have been brought about no changes of any consequence, though there seems to be a tendency towards decreased amount, as the period of storing continues. This difference will be

brought out more clearly when we come to consider the next table (XI), which will give us a comparison of the *average analyses* of the potatoes at different periods during storing. When we come to consider the sucrose percentages, we observe that the increase in the same is uniform throughout as the period of storing is extended. The increase in the amount of sugar found in the potatoes on storing accounts at least in a measure for the deficiency in the starch content observed. Before leaving this particular part of the work, we will consider a table showing a comparison of the average composition of these samples of potatoes (fertilized with different forms of potash) at the different intervals during the period of storing. Table XI will give us this information:

TABLE XI.

AVERAGE ANALYSES OF POTATOES (FERTILIZED WITH DIFFERENT FORMS OF POTASH) AT DIFFERENT PERIODS DURING STORING.

Period at which samples were analyzed.	Original.				Air-dry.				Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Nov. 28th, 1898.......	64.29	22.02	1.26	5.79	7.61	57.21	3.26	14.97	61.92	3.53	16.20
March 1st, 1899........	66.83	16.87	1.16	6.94	6.94	47.34	3.25	19.48	50.87	3.49	20.93
April 17th, 1899.......	66.09	16.39	0.69	7.64	7.58	44.68	1.88	20.82	48.34	2.03	22.53

From these average results, we observe, as has been stated before, that the water content of these particular potatoes has increased somewhat on storing. This increase is not entirely uniform, as an inspection of the above table will show, but is nearly so. For instance, the average percentage of water in the potatoes analyzed April 17th, 1899, is only about seven-tenths (0.7) per cent. less than that found in the same when analyzed March 1st, 1899. This difference can be attributed partially, at least, to errors, such as differences in sampling and differences due to the determination itself. These particular results are interesting in that they indicate that the sweet potato, on storing, does not lose water, at least, to the extent commonly believed. On the contrary, from these particular results, it appears that there is a slight gain in water content. We observe, also, in this table a gradual increase in the percentages of sucrose (cane sugar) accompanied in all cases by a gradual decrease of starch. This average increase in the cane sugar (sucrose) content of the potato, however, is not sufficient to account wholly for the average decrease of starch noticed, except in the period from March 1st, 1899, to April 17th, 1899. For instance, if we consider, as we have not done as yet, the average loss of starch for the whole period, from November 28th, 1898, to April 17th, 1899, on the one hand and the average gain of sucrose (cane sugar) on the other, we will

observe that the latter will not be sufficient to account wholly for the former. For instance, there has been an average increase of 1.85 per cent. of sucrose during this period and an average decrease of 5.63 per cent. of starch. Now, if this loss of starch is to be attributed solely to the formation of sucrose (cane sugar) we would expect the following equation to represent the true state of affairs:

$$\underset{\text{(Starch)}}{\overset{324.}{2\,C_6H_{10}O_5}} : \underset{\text{(Sucrose)}}{\overset{342.}{C_{12}H_{22}O_{11}}} = \underset{\substack{\text{(Loss of starch}\\ \text{on storing)}}}{5.63} : \times$$

in which X will give us the percentage of sucrose (or cane sugar) equivalent to 5.63 per cent. of starch. On solving this equation, we find X to be 5.94 per cent. But as the increase of sucrose amounts only to 1.85 per cent. during this period, we observe, therefore, that in so far as these particular experiments are concerned, the loss of starch sustained by the sweet potato on storing cannot be attributed solely to the increased formation of sucrose (cane sugar) in the same. From the table just presented, we notice also that the glucose content of these potatoes seems to remain about the same on storing though there is a slight tendency to a loss in the same, as the period of storing advances to any considerable extent.

EFFECT OF STORING UPON THE COMPOSITION OF THE POTATOES OF DIFFERENT VARIETIES.

In the work just discussed, it will be noticed that the results refer in all cases to the changes in composition of the same variety of potato (but fertilized with different forms of potash) sustained on storing. Our object here was to ascertain if there was any relation between the keeping qualities of the potato and the form of potash, with which it was fertilized. Our particular object here is to ascertain if there is any relation between the keeping qualities of the potato and the variety of the same. Several varieties were used, all being planted on plots, the soil of which had the same general character, and all being fertilized and cultivated alike. The varieties of potatoes used in this particular part of the work are given in Table XII, along with their yield per acre, in pounds. In the first column of this table is given the number of the variety, in the second, name of the variety, and in the third, the yield per acre in pounds.

TABLE XII.

VARIETIES OF POTATOES, INCLUDING YIELDS PER ACRE, USED IN THESE EXPERIMENTS.

Number of Variety.	Name of Variety.	Yield Per Acre. Pounds.
1.	Georgia Buck.	19,920
2.	Bunch Yam.	15,414
3.	Bunch Yam, from different source.	23,112
4.	Horton Yam.	20,790
6.	Georgia Buck, from different source.	17,772
7.	Vineless Yam.	19,326
9.	Hanover Yam.	20,358
10.	Georgia Yam.	21,306

These potatoes were harvested in the early part of November, 1898, but, unfortunately, a few weeks were allowed to elapse before samples of the same were sent in for analysis. Consequently, we would naturally expect to find the percentage of starch somewhat low and the percentage of the sugars (glucose, and especially sucrose) somewhat high. This we find to be true, as the following results will show. The low percentages of starch and the high percentage of sugars in these potatoes can be accounted for possibly, also, by the fact that practically all of the potatoes used in this test are table varieties. These, we know from experiment, as well as from practical observation, are inclined to contain more sugar and less starch than those of some other varieties commonly used. We will consider next a table showing the yield of starch produced per acre by the different varieties of potatoes under consideration. Table XIII will give this information, columns one and two showing the names and varieties of the potatoes experimented with, column three the percentage of starch in the potatoes and column four the yield of starch per acre in pounds.

TABLE XIII.

YIELDS OF STARCH PRODUCED PER ACRE BY THE DIFFERENT VARIETIES OF POTATOES EXPERIMENTED WITH.

Number of Variety.	Name of Variety.	Per Cent. of Starch in Potatoes.	Yield of Starch Per Acre in Pounds.
1.	Georgia Buck	13.13	2,616
2.	Bunch Yams.	15.12	2,331
3.	Bunch Yams from different sources.	19.58	4,525
4.	Horton Yam.	15.06	3,131
6.	Georgia Bucks from different sources.	14.35	2,550
7.	Vineless Yams.	16.85	3,256
9.	Hanover Yams.	13.61	2,771
10.	Georgia Yams.	18.87	4,020

In considering the results in the above table, we observe that while the percentages of starch in these potatoes are quite low, especially in some instances, yet the actual amount of starch produced per acre is in all, except three cases, above that accepted in Bulletin 28 of this

Station as representing the average yield of starch per acre to be obtained from the sweet potato, namely: *2,640 pounds*. This is due, of course, to the fact that the yields of potatoes per acre are higher as a rule in the cases under consideration than the figures accepted in Bulletin 28, above referred to, as representing the average yield obtainable in practice under our conditions, namely, 200 bushels, or 12,000 pounds. From the results in the table under consideration, we notice that of the particular varieties used in this experiment, Bunch Yam, from one source (No. 3) seems to have produced the largest amount of starch per acre, followed closely by Georgia Yam and also that Bunch Yam from another source (No. 2) has produced the smallest yield of starch per acre. We have illustrated here very strikingly the great difference in the productive capacity of potatoes, the seed of which belong to the same general variety, but which came from different sources. This necessitates careful attention in the selection and propagation of our seed. The yields of starch per acre are about the same in the case of the Georgia Buck varieties from the two sources. That designated No. 1 in the table contains a little more starch than the other designated as No. 6. The average yield of potatoes per acre (*19,750 pounds*), as well as that of starch (*3,124.5 pounds*) in the above experiment are both higher than the average usually accepted for the same in our work, namely: in the first instance, *12,000 pounds,* and in the second, *2,640 pounds.* We are safe, apparently, in accepting the averages which have been just given. The first samples of these potatoes were sent in for analysis November 28, 1898, the balance being immediately stored. Determinations of water, starch, glucose and sucrose were immediately made with the following results. Table XIV will give us this information, column one giving the number of the variety, column two the name of the same and columns three, four and five the percentages of water, starch, glucose and sucrose in the original, and air-dry material, starch, glucose and sucrose in the water-free material.

TABLE XIV.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.

First Lot (Nov. 28th, 1898.)

Number of Variety.	Name of Variety.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	Georgia Buck.. ..	75.35	13.13	0.77	4.31	6.79	49.65	2.93	16.31	53.27	3.14	17.50
2.	Bunch Yam... ..	72.37	15.12	1.09	4.45	6.67	51.06	3.67	15.04	54.71	3.93	16.11
3.	*Bunch Yam... ..	67.99	19.58	0.56	4.49	7.24	56.70	1.61	13.02	61.18	1.74	14.04
4.	Horton Yam.. ..	70.29	15.06	1.05	6.23	6.24	47.52	3.31	19.67	50.68	3.53	20.98
6	*Georgia Buck.. ..	71.56	14.35	0.73	6.61	6.88	46.98	2.40	21.63	50.45	2.58	23.23
7.	Vineless Yam.. ..	70.03	16.85	0.54	5.01	7.90	51.78	1.67	15.40	56.22	1.81	16.72
9.	Hanover Yam.. ..	76.16	13.61	1.10	4.22	7.37	52.89	4.29	16.40	57.10	4.63	17.70
10.	Georgia Yam.. ..	70.01	18.87	1.00	4.08	7.57	58.17	3.07	12.59	62.93	3.32	13.62

*From different source.

From the results in the above table, we notice that Bunch Yam, No. 3, contains the highest percentage amount of starch of any of the varieties tested, followed closely by Georgia Yams, No. 10. Georgia Buck, No. 1, contains the lowest percentage of starch, followed closely by Hanover Yam, No. 9. The percentage of sucrose is highest in Georgia Buck, No. 6, and lowest in Georgia Yam, No. 10, basing all comparison on original material. We observe, also, a relation here, though not entirely uniform, between the amounts of starch and sucrose contained in these potatoes. A high percentage of starch being accompanied usually with a low percentage of sugar (sucrose), and vice versa. There are no very great differences in the percentages of glucose contained in the potatoes of the different varieties, with the possible exception of the figures obtained on Bunch Yam, No. 3, and Vineless Yam, No. 7, which appear to be somewhat low. These figures serve to confirm the statement already made, namely, that the glucose content of the sweet potato is a fairly uniform quantity. We consider now a table showing the average composition of the potatoes of all varieties, when first analyzed (November 28th, 1898). These results are obtained from those just given. Table XV will give us this average analysis, and we will now consider the same:

TABLE XV.

AVERAGE ANALYSIS OF THE POTATOES OF DIFFERENT VARIETIES.

First Lot (Nov. 28th, 1898.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose Per Cent.
71.72	15.78	0.87	4.95	7.08	51.84	2.87	16.26	55.79	3.09	17.50

From the results in this table, we observe the average percentage of water found in these potatoes is somewhat higher than that found for those fertilized with different forms of potash. This is to be attributed undoubtedly to the fact that these potatoes were stored in the beginning in a somewhat wet condition, as has been already pointed out. The average percentages of glucose and sucrose found here are about the same as those found for the first lot of potatoes, fertilized with different forms of potash, basing our comparisons on the results obtained in the original material. The second lot of potatoes of the different varieties were taken for analysis on January 7th, 1899, forty (40) days having thus elapsed since the first lot of the same were analyzed. The results of the analyses of the second lot of potatoes are to be found in the table below, which we designate as XVI:

TABLE XVI.
ANALYSES OF THE POTATOES OF DIFFERENT VARIETIES.
Second Lot (Jan. 7th, 1899.)

Number of Variety.	Name of Variety.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
1.	Georgia Buck.. ..	69.74	12.72	1.75	9.25	8.80	38.34	5.27	27.87	42.04	5.78	30.56
2.	Bunch Yam... ..	67.31	13.66	2.02	9.90	9.49	37.83	5.60	27.40	41.80	6.19	30.27
3.	*Bunch Yam... ..	67.29	13.83	2.40	9.43	10.00	38.04	6.61	25.94	42.27	7.34	28.82
4.	Horton Yam... ..	71.39	9.57	2.57	9.69	7.18	31.05	8.35	31.43	33.45	9.00	33.86
6.	*Georgia Buck.. ..	67.63	14.43	2.12	7.85	8.46	40.80	6.00	22.21	44.57	6.55	24.26
7.	Vineless Yam.. ..	67.33	12.03	2.90	10.09	7.90	33.90	8.19	28.44	36.81	8.89	30.88
9.	Hanover Yam.. ..	70.13	14.13	1.66	6.58	9.29	42.90	5.05	19.99	47.29	5.57	22.04
10.	Georgia Yam.. ..	71.78	11.21	2.26	8.10	8.62	36.30	7.31	26.24	39.72	8.00	28.72

*From different source.

On comparing these results with those in Table XIV, we observe that, in every case, with the exception of results in the cases of numbers 1 and 10, there has been found a slightly smaller percentage of water. The differences in most cases, however, are very small. We observe also in these results a fairly uniform relation between the decrease of starch and increase of sucrose. For instance, we find that Georgia Buck, No. 6, contains the highest percentage of starch, and, with one exception, the lowest percentage of sucrose. We find also that Hanover Yam, No. 9, contains the next highest percentage of starch and the lowest percentage of sucrose. Comparing the results on starch, sucrose and glucose, obtained in this table, with those in Table XIV, we notice in the first place that almost invariably the starch percentages have decreased and in some cases very strikingly. From this particular experiment, it would appear that the varieties Georgia Buck (Nos. 6 and 1), and Hanover Yam (No. 9) have preserved their starch content the best. In the cases of Georgia Buck (No. 6) and Hanover Yam (No. 9) a slight increase in starch percentages is to be noted, but this is to be attributed solely to the differences resulting from sampling. Horton Yam (No. 4) has shown itself to be a potato disposed to sustain large losses of starch on storing. The same remark seems to be true also for Georgia Yam (No. 10). The percentages of sucrose in all of the varieties of the second lot are uniformly and considerably higher than those found in the first lot. The greatest increase in sucrose seems to have taken place in the case of Bunch Yams (No. 2) and the smallest in the case of Georgia Buck (No. 6). When we come to consider the glucose percentages, we find that, without exception, the results for the second lot of potatoes are higher. In a few cases, considerably higher. This would seem to indicate that sweet potatoes *stored in a damp condition,* are subject at least to two definite and distinct sources of loss, in so far as the question is

one of starch conservation; first, the formation of glucose; second, the formation of sucrose. From the results, which we considered some few pages back, in regard to the changes in composition on storing of the sweet potato, fertilized with different forms of potash, we will observe that when the sweet potato is stored in good condition, the percentages of glucose remain nearly stationary. This fact will also be proven to be true by work, the results of which follow. We see, therefore, that in so far as the first source of loss is concerned, namely: the increased formation of glucose, it is possible to regulate in a measure the extent of the same. We will consider now a table showing the average of the analyses of all varieties of the second lot, samples of which were taken on January 7th, 1899.

Table XVII will give us this information, the first four columns giving the percentages of water, starch, glucose and sucrose in the original material, the second four, the same results in the air-dry material and the third three columns, the percentages of starch, glucose and sucrose, respectively, in the water-free material.

TABLE XVII.

AVERAGE ANALYSIS OF THE POTATOES OF DIFFERENT VARIETIES.

Second Lot (Jan. 7th, 1899.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
69.08	12.67	2.22	8.87	8.72	37.40	6.55	26.19	40.97	7.18	28.69

On comparing these average results with those obtained on the first lot (Table XV), we will observe that the average water-content has decreased some little in this case on storing. The average decrease, however, is only very slight, and amounts to but 3.7 (three and seven tenths) per cent. of the total quantity of water originally present. In regard to the starch percentage, we observe that there has been a considerable decrease during the period from November 28th, 1898, to January 7th, 1899. The average decrease amounts to about 19.8 (nineteen and eight-tenths) per cent. of the total quantity of starch originally present in the potatoes. This, we see, is quite a large loss, especially when we come to consider the fact that it has been sustained during a period of only about 40 days. This is a larger loss of starch than we would expect to find from the results, which were obtained with the potatoes fertilized with different forms of potash. This increased rate of loss of starch is to be attributed undoubtedly to the fact that these potatoes were stored in a damp condition. We notice that there has been a considerable increase in the average percentage of sucrose, the average figures for this constituent

being 4.95 in the first lot of potatoes and 8.87 in the second lot. This is a considerable gain, amounting as it does to 79.2 (seventy-nine and two-tenths) per cent. of the total quantity of sucrose originally present. We see here, therefore, a uniformity between the increase of sugar and the decrease of starch. The question now is, will this increased amount of sugar found account for the decrease in starch observed? The following equation expresses the change of starch to sugar (sucrose):

$$\underset{\text{(Starch)}}{\overset{324.}{2\,C_6H_{10}O_5}} : \underset{\text{(Sucrose)}}{\overset{342.}{C_{12}H_{22}O_{11}}} = \underset{\text{(Loss of starch on storing)}}{3.11} : \times$$

In this equation X will give us the percentage of sucrose equivalent to the starch lost on storing. On solving this equation, we find X, or the percentage of sucrose, to be 3.3 (three and three-tenths). Now, we have seen already that there has been an average actual gain of sucrose of 3.9 (three and nine-tenths) per cent. in the case of the second lot as compared with the first. Hence, the decrease in the starch content in this case can be attributed to the increased formation of sucrose or cane sugar. It appears from the results in Tables XVII and XVI that the average percentage of glucose has also increased quite considerably in the second lot as compared with the first. The conclusion seems to be warranted from this fact that the starch content of sweet potatoes, stored under unfavorable conditions (when damp, etc.,) is liable to experience a rapid decrease with the consequent production of increased quantities of both glucose and sucrose. It appears on the other hand in the case of potatoes stored properly and in good condition that the decrease of the starch content is not so rapid, nor is there any very appreciable increase in the glucose content, as is the case just noted. Some few weeks after the last analyses were made of these potatoes (January 7th, 1899,) it was observed that they were beginning to rot very rapidly, so much so that it was not deemed advisable to make any more analyses of the same. In order, now, that we may see at a glance the behavior of the potatoes of these different varieties on storing, I will construct a table which will give the results of the analyses of the two lots of the same. This table will be designated as XVIII, and we will now consider the same:

TABLE XVIII.

CHANGES IN COMPOSITION OF THE SWEET POTATO OF DIFFERENT VARIETIES ON STORING.

First Lot (Nov. 28th, 1898.)

Number of Variety.	Name of Variety.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose. Per Cent.
1.	Georgia Buck.. ..	75.35	13.13	0.77	4.31	6.79	49.65	2.93	16.31	53.27	3.14	17.50
2.	Bunch Yam... ..	72.37	15.12	1.09	4.45	6.67	51.06	3.67	15.04	54.71	3.93	16.11
3.	*Bunch Yam... ..	67.99	19.58	0.56	4.49	7.24	56.70	1.61	13.02	61.18	1.74	14.04
4.	Horton Yam.. ..	70.29	15.06	1.05	6.23	6.24	47.52	3.31	19.67	50.68	3.53	20.98
6.	*Georgia Buck.. ..	71.56	14.35	0.73	6.61	6.88	46.98	2.40	21.63	50.45	2.58	13.23
7.	Vineless Yam.. ..	70.03	16.85	0.54	5.01	7.90	51.78	1.67	15.40	56.22	1.81	16.72
9.	Hanover Yam.. ..	76.16	13.61	1.10	4.22	7.37	52.89	4.29	16.40	57.10	4.63	17.70
10.	Georgia Yam.. ..	70.01	18.87	1.00	4.08	7.57	58.17	3.07	12.59	62.93	3.32	13.62

*From different source.

TABLE XVIII.—Concluded.

Second Lot (Jan. 7th, 1899.)

Number of Variety.	Name of Variety.	Original.				Air-dry.				Water-free.		
		Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose. Per Cent.	Sucrose, Per Cent.
1.	Georgia Buck.. ..	69.74	12.72	1.75	9.25	8.80	38.34	5.27	27.87	42.04	5.78	30.56
2.	Bunch Yam... ..	67.31	13.66	2.02	9.90	9.49	37.83	5.60	27.40	41.80	6.19	30.27
3.	*Bunch Yam... ..	67.29	13.83	2.40	9.43	10.00	38.04	6.61	25.94	42.27	7.34	28.82
4.	Horton Yam.. ..	71.39	9.57	2.57	9.69	7.18	31.05	8.35	31.43	33.45	9.00	33.86
6.	*Georgia Buck.. ..	67.63	14.43	2.12	7.85	8.46	40.80	6.00	22.21	44.57	6.55	24.26
7.	Vineless Yam.. ..	67.33	12.03	2.90	10.09	7.90	33.90	8.19	28.44	36.81	8.89	30.88
9.	Hanover Yam.. ..	70.13	14.13	1.66	6.58	9.29	42.90	5.05	19.99	47.29	5.57	22.04
10.	Georgia Yam.. ..	71.78	11.21	2.26	8.10	8.62	36.30	7.31	26.24	39.72	8.00	28.72

*From different source.

From the results in this table, it appears that Hanover Yam (No. 9) has preserved its starch content the best of any of the varieties tested in this particular experiment. We also observe that the increase of the sucrose content has been the smallest in this case, with the exception of Georgia Buck (No. 6.) Following closely the Hanover Yam, we find the Georgia Buck varieties (Nos. 1 and 6) to have given the next best results. The variety Georgia Yam (No. 10) seems to have given the poorest results of any variety tested. It must be borne in mind, however, that these conclusions are based on the work of one year only, and, therefore, should not be accepted as final. Lastly, we will consider a comparison of the average analyses of all varieties of the two lots worked upon (November 28th, 1898, and January 7th, 1899.) Table XIX will give this comparison and we will now consider the same.

TABLE XIX.

A COMPARISON OF THE AVERAGE ANALYSES OF THE POTATOES OF ALL VARIETIES MADE DURING THE PERIOD OF STORING.

First Lot (Nov. 28th, 1898.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent	Glucose, Per Cent.	Sucrose, Per Cent.
71.72	15.78	0.87	4.95	7.08	51.84	2.87	16.26	55.79	3.09	17.50

TABLE XIX.—Concluded.

Second Lot (Jan. 7th, 1899.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
69.08	12.67	2.22	8.87	8.72	37.40	6.55	26.19	40.97	7.18	28.69

The average loss of starch in these experiments amounts to 19.7 per cent. of that originally present. In the light of what we have found to be the losses of starch in the potatoes, fertilized with different forms of potash, we cannot say this is such an extreme figure; if anything, however, it is above the average.

WORK OF OTHERS ON THE CHANGES WHICH THE SWEET POTATO UNDERGOES ON STORING.

The work, some of the results of which have just been reported, was continued by Mr. C. C. McDonnell during my absence from the Station in the session of 1899-1900. Mr. McDonnell's work was confined to four varieties, as follows: Pumpkin Yam, Bunch Yam, Georgia Sugar Yam and Tennessee Yam. The first samples were sent in for analysis November 14th, 1899. The potatoes were dug about Oct. 31. A period of about 2 weeks had thus elapsed between the date on which these potatoes were dug and the date on which the first samples were received at the laboratory. This fact accounts, therefore, in part, at least, for the comparatively high percentages of sucrose and low percentages of starch found in these samples. We would, however, expect these potatoes naturally to be somewhat higher in sucrose than the ordinary varieties, since they are all table varieties. Table XX gives us the analyses of the first lot of potatoes sent in for analysis, November 14th, 1899.

TABLE XX.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.

First Lot, Received Nov. 14th, 1899. (C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Pumpkin Yam..	68.94	17.38	1.08	5.17	52.68	3.26	15.67	55.97	3.46	16.65
Bunch Yam..	72.04	13.72	1.38	5.47	45.89	4.63	18.29	49.07	4.95	19.56
Georgia Sugar Yam..	67.81	18.41	1.08	5.08	53.97	3.17	14.89	57.20	3.36	15.78
Tennessee Yam..	70.42	15.74	1.41	5.02	50.12	4.48	15.98	53.20	4.76	16.96

These potatoes are somewhat low in starch, the average in the original material being 16.31 per cent. On the other hand, the percentages of glucose and especially sucrose are high, the averages in the original material being 1.23 and 5.19 respectively. These results are to be attributed at least partially if not entirely, to the fact that a period of about two weeks elapsed between the time of harvesting and analysis. The fact that these samples are table varieties would account also in a measure for the high percentages of sugar found. Table XXI will give us the analyses of the second lot of potatoes sent in for analysis December 14th, 1899, and analyzed by Mr. McDonnell:

TABLE XXI.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.

Second Lot, Received Dec. 14th, 1900. (C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Pumpkin Yam..	71.07	14.57	1.12	5.93	48.15	3.69	19.61	50.37	3.86	20.51
Bunch Yam..	80.25	9.61	0.78	4.17	47.60	3.77	20.19	49.78	3.94	21.12
Georgia Sugar Yam..	70.41	16.83	1.24	5.07	54.53	4.03	16.44	56.87	4.20	17.15
Tennessee Yam..	71.51	14.71	1.11	5.67	49.64	3.74	19.13	51.63	3.89	19.90

On comparing these figures with those in Table XX, we will observe that in each case there has been an increase in the percentage of water in the samples of the second lot as compared with those of the first lot. We notice, further, that there has been a very striking decrease in the percentages of starch in the samples of the second lot as compared with those of the first. This decrease in starch content has been followed as a rule by a corresponding increase in the sucrose, or cane sugar, content. The glucose percentages have suffered little change. Table XXII gives us the analyses of the third lot of potatoes, sent in for analysis January 15th, 1900, and analyzed, as before, by Mr. McDonnell:

TABLE XXII.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.
Third Lot, Received Jan. 15th, 1900. (C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Pumpkin Yam..	71.78	10.05	2.59	8.83	34.09	8.80	29.96	35.61	9.19	31.30
Bunch Yam..	69.59	12.30	1.73	8.61	38.75	5.46	27.12	40.46	5.70	28.32
Georgia Sugar Yam..	67.87	14.98	1.73	8.14	44.62	5.46	24.24	46.63	5.71	25.33
Tennessee Yam..	68.71	14.74	1.84	7.37	45.20	5.65	22.61	47.09	5.89	23.56

We observe here on comparison of these figures with those in Table XX, that on the whole there has been a continued decrease in starch content in these samples accompanied by an increase in sucrose content. The glucose percentages have experienced, as a rule, little change. However, there seems to be a tendency towards an increased amount in the case of these samples, especially with Pumpkin Yams and Bunch Yams. Table XXIII will give us the analyses of the fourth lot of potatoes, sent in for analysis February 15th, 1900.

TABLE XXIII.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.
Fourth Lot, Received Feb. 15th, 1900. (C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Pumpkin Yam..	75.78	10.08	1.45	7.12	40.22	5.80	28.44	41.61	6.00	29.42
Bunch Yam..	74.67	8.18	1.64	9.48	31.22	6.25	36.18	32.30	6.48	37.43
Georgia Sugar Yam..	69.87	13.76	1.45	8.78	44.39	4.69	28.34	45.65	4.82	29.14
Tennessee Yam..	69.68	13.25	1.18	9.05	42.51	3.79	29.04	43.54	3.88	29.74

On comparing these results with those in the preceding table (XXII), we observe that the starch percentages on the whole continue to decrease while the sucrose percentages, on the other hand, as a rule, continue to increase. The glucose percentages again seem to have experienced comparatively little alteration. Here, as in all other cases, we are struck again with the approximate constancy of the water content of these samples of potatoes on storing. There is an apparently slight tendency in each case to an increase in the water content on storing, contrary to the generally accepted ideas on the subject. Table XXIV gives us the analyses of the fifth and last lot of potatoes, sent in for analysis March 15th, 1900:

TABLE XXIV.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.

Fifth Lot, Received March 15th, 1900. (C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
Pumpkin Yam..	69.48	11.12	1.04	11.59	34.20	3.21	35.67	36.42	3.42	37.99
Bunch Yam..	72.57	8.83	1.68	11.70	30.12	5.73	39.94	32.17	6.12	42.66
Georgia Sugar Yam..	67.63	13.42	1.10	11.96	39.02	3.19	34.78	41.47	3.39	36.96
Tennessee Yam..	76.02	9.94	1.15	9.75	38.85	4.48	38.12	41.44	4.78	40.66

On comparing these results with those in the preceding table (XXIII), we observe that the percentages of sucrose continue to increase regularly, while on the other hand, the tendency of the starch percentages is towards a decrease. The percentages of glucose seem to remain on the whole about the same. We consider next a table (XXV) which presents the preceding analyses of the different lots of potatoes on storing in such way that a comparison between the same is possible at a glance.

TABLE XXV.

ANALYSES OF POTATOES OF DIFFERENT VARIETIES ON STORING.

(C. C. McDonnell, Analyst.)

Name of Variety.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
First Lot. Nov. 14th, 1899.										
Pumpkin Yam..	68.94	17.38	1.08	5.17	52.68	3.26	15.67	55.97	3.46	16.65
Bunch Yam..	72.04	13.92	1.38	5.47	45.89	4.63	18.29	49.07	4.95	19.56
Georgia Sugar Yam..	67.81	18.41	1.08	5.08	53.97	3.17	14.89	57.20	3.36	15.78
Tennessee Yam..	70.42	15.74	1.41	5.02	50.12	4.48	15.98	53.20	4.76	16.96
Second Lot. Dec. 14th, 1899.										
Pumpkin Yam..	71.07	14.57	1.12	5.93	48.15	3.69	19.61	50.37	3.86	20.51
Bunch Yam..	80.25	9.61	0.78	4.17	47.60	3.77	20.19	49.78	3.94	21.12
Georgia Sugar Yam..	70.41	16.83	1.24	5.07	54.53	4.03	16.44	56.87	4.20	17.15
Tennessee Yam..	71.51	14.71	1.11	5.67	49.64	3.74	19.13	51.63	3.89	19.90
Third Lot. Jan. 15th, 1900.										
Pumpkin Yam..	71.78	10.05	2.59	8.83	34.09	8.80	29.96	35.61	9.19	31.30
Bunch Yam..	69.59	12.30	1.73	8.61	38.75	5.46	27.12	40.46	5.70	28.32
Georgia Sugar Yam..	67.87	14.98	1.73	8.14	44.62	5.46	24.24	46.63	5.71	25.33
Tennessee Yam..	68.71	14.74	1.84	7.37	45.20	5.65	22.61	47.09	5.89	23.56
Fourth Lot. Feb. 15th, 1900.										
Pumpkin Yam..	75.78	10.08	1.45	7.12	40.22	5.80	28.44	41.61	6.00	29.42
Bunch Yam..	74.67	8.18	1.64	9.48	31.22	6.25	36.18	32.30	6.48	37.43
Georgia Sugar Yam..	69.87	13.76	1.45	8.78	44.39	4.69	28.34	45.65	4.82	29.14
Tennessee Yam..	69.68	13.25	1.18	9.05	42.51	3.79	29.04	43.54	3.88	29.74
Fifth Lot. March 15th, 1900.										
Pumpkin Yam..	69.48	11.12	1.04	11.59	34.20	3.21	35.67	36.42	3.42	37.99
Bunch Yam..	72.57	8.83	1.68	11.70	30.12	5.73	39.94	32.17	6.12	42.66
Georgia Sugar Yam..	67.63	13.42	1.10	11.96	39.02	3.19	34.78	41.47	3.39	36.96
Tennessee Yam..	76.02	9.94	1.15	9.75	38.85	4.48	38.12	41.44	4.78	40.66

This table brings out again very strikingly the change of starch into sucrose on the storing of the sweet potato. The fact that the sweet potato on storing loses very little water is also confirmed by these particular experiments. In fact, there is a slight gain in a majority of the samples here analyzed. The glucose content of the sweet potato seems to suffer little change in storing. We consider now a table giving a comparison between the average analyses of the different lots. Table XXVI will give us this information and we will now consider the same:

TABLE XXVI.

AVERAGE ANALYSES OF THE POTATOES OF DIFFERENT VARIETIES ON STORING.

(C. C. McDonnell, Analyst.)

Dates When Analyzed.	Original.				Air-dry.			Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
First lot, Nov. 14th, 1899......	69.80	16.27	1.25	5.21	50.67	3.89	16.21	53.86	4.13	17.24
Second lot, Dec. 14th, 1899.....	73.31	13.92	1.06	5.25	48.73	3.81	18.84	52.16	3.97	19.67
Third lot, June 15th, 1900......	69.49	12.95	2.02	8.28	40.67	6.34	25.98	42.45	6.62	27.13
Fourth lot, Feb. 15th, 1900.....	72.50	11.21	1.46	8.64	39.59	5.12	30.50	40.78	5.30	31.43
Fifth lot, Nov. 15th, 1900......	71.43	10.92	1.27	11.31	35.55	4.15	37.13	37.88	4.43	39.57

We observe from the results in this table that there is on the whole a constant decrease in starch content, accompanied by a corresponding increase in sucrose (cane sugar) content, as the period of storage is extended. The average water content of the potatoes on storing in these particular experiments seems to vary in very narrow limits. There seems, in fact, to be no loss of water on storing in so far as these particular experiments are concerned, but on the other hand, there seems to be a slight gain. This is contrary to the popular opinion on the subject and confirms the results of the writer reported in the preceding pages. We see that the average percentage of starch in these potatoes when first analyzed was 16.27 in the original material; when last analyzed, 10.92. There has been an average loss, therefore, of 5.35 per cent. of starch in the original material as a result of storing. This loss is equivalent to thirty three (33) per cent. of the total amount of starch originally present in the potatoes. On the other hand, we see that the average percentage of sucrose in these potatoes, when first analyzed, was 5.21 in the original material; when last analyzed, 11.31. There has been, therefore, an average gain of 6.10 per cent. of sucrose in the original material, as the result of storing. This gain in sucrose is equivalent to one hundred and seventeen (117) per cent. of the total amount of the same originally present in the potatoes. It will be interesting now to ascertain if this loss of starch can be attributed to the increased formation of su-

crose in the potatoes on storing. We will now make the usual calculation and see if such proves to be the case:

$$\overset{324.}{2\,C_6H_{10}O_5}\;:\;\overset{342.}{C_{12}H_{22}O_{11}} = 5.35 : \times$$
(Starch) (Sucrose) (Loss of starch on storing)

in which X will give us the amount of sucrose equivalent to 5.35 per cent. of starch, which has been lost on storing. On solving this equation, we find X to be equivalent to 5.65 per cent. of sucrose. Now, as a matter of fact, we have found that in practice there has been an actual gain of 6.11 per cent. of sucrose, a result, which agrees quite closely with the calculated figures from the equation. The average percentages of glucose seem on the whole to remain unchanged.

Several years ago, some work along the same line as that reported in the preceding pages was undertaken by the Texas Station, the results of which are reported in Bulletin No. 36, pages 628 and 629 of that Station. The reason for undertaking the work in question was that: "It was thought an analysis of the potato at various times during the winter season would be of interest, as showing variation of the water and sugar contained." Some sixteen samples were used in the experiment, though it is stated that "some of them may be the same or nearly the same variety." The analyses were made November 1st, December 20th, and March 6th. The results of this work are compiled in Table XXVII, and we will now consider the same. The results are stated in percentages of water, invert sugar and total sugars, as contained in the original material:

TABLE XXVII.
ANALYSES OF THE POTATOES AT DIFFERENT PERIODS.
(Texas Station).

Name of Variety.	November 1st, 1893.			December 20th, 1893.			March 6th, 1894.		
	Water, Per Cent.	Invert Sugar, Per Cent.	Total Sugar, Per Cent.	Water, Per Cent.	Invert Sugar, Per Cent.	Total Sugar, Per Cent.	Water, Per Cent.	Invert Sugar, Per Cent.	Total Sugar, Per Cent.
Bunch Yam.	70.83	2.14	3.74	68.92	6.41	12.50	68.85	4.06	14.38
Early Bunch Yam.	73.26	2.66	4.60	65.01	5.55	10.00	60.81	7.25	19.71
Vineless.	66.06	4.16	6.41	66.03	6.02	12.50	62.90	6.10	16.42
Nansemand	71.81	3.33	5.00	70.34	3.73	5.88	70.14	3.09	8.00
Red Nose.	77.59	3.27	5.20	72.84	3.15	6.00	68.76	4.75	11.13
Brazilian Yam. . .	67.23	2.52	5.26	66.98	5.55	11.11	60.55	5.80	15.30
Negro Choker . . .	68.23	2.84	7.69	66.71	5.00	9.60	61.72	5.75	11.50
Tennessee.	65.83	2.19	2.77	64.01	5.26	11.63	59.84	7.16	13.80
Southern Queen...	61.58	5.10	9.20	60.00	7.35	10.50	58.12	5.56	10.64
Red Bermuda.....	75.81	2.77	5.26	71.47	6.10	7.20	70.82	3.45	8.84
Early Golden . . .	74.70	3.00	6.75	66.56	4.54	7.14	.....	.....	.....
Peabody.	79.04	3.35	6.41	76.97	3.50	6.00	70.00	3.34	10.30
Delaware.	78.26	2.08	5.00	67.87	5.50	7.46	50.00	1.15	7.55
Barbadoes.	75.44	2.92	6.98	61.64	5.00	8.98	59.50	2.79	11.50
Norton	66.69	4.67	11.90	65.26	6.66	12.10	.....	.....	.....
Pumpkin.	69.19	3.76	8.07	69.66	6.25	9.95	67.00	4.60	13.27

Unfortunately, starch was not determined in any of these samples, hence we have no means for judging, in so far as these particular experiments are concerned, of the loss of starch content as the period of storage was extended. By subtracting in each case the percentages of invert sugar from the percentages of total sugar, we arrive at some idea of the increase in the cane sugar content as the period of storing advances. In the majority of cases, there is an increase in the invert sugar content of these potatoes as well as in the cane sugar content, as the period of storing advances. The increase in the sucrose, or cane sugar, content of these particular samples of potatoes on storing confirms very strikingly the results which have been reported in the preceding pages of this bulletin. As the author remarks: "The increase of invert sugar, comprising grape sugar and fruit sugar is not so uniform as that of total sugar, comprising cane sugar in addition to invert." In so far as the water content of these particular samples of potatoes is concerned, we find that in most cases the loss of water on storing is quite slight. This confirms the conclusion drawn in the preceding pages that sweet potatoes stored in good condition lose, under ordinary circumstances, a comparatively small amount of water, and, in fact, may under certain circumstances, gain slightly in water content. The author remarks, in regard to changes in the water content of these samples that "the amount of water which they lost in keeping seems to have been very little." The statement is also made that "so far as these analyses indicate, the early Bunch Yam would seem to be the best potato for table use where a dry potato with a large amount of sugar is wanted. The next best answering the purpose would be Pumpkin Yam. But I believe it is a fact that dry, mealy potatoes, low in sugar, are more appreciated in the Northern market than are the yellow Yams, rich in sugar." We will consider next a table showing a comparison of the average analyses of the samples of potatoes of the three lots analyzed, the results of which are reported in the preceding table. This table is designated as XXVIII, and is obtained simply by averaging the results in the preceding table for the three lots of samples analyzed. The results given in the column headed "Sucrose," were obtained by subtracting the figures given for invert sugar from those given for total sugar. This will make the results, in so far as the sucrose, or cane sugar is concerned, more comparable with those given in the preceding pages.

TABLE XXVIII.

AVERAGE ANALYSES OF THE POTATOES AT DIFFERENT PERIODS.
(Texas Station.)

November 1st, 1893.				December 20th, 1893.				March 6th, 1894.			
Water, Per Cent.	Invert Sugar, Per Cent.	Total Sugar, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Invert Sugar, Per Cent.	Total Sugar Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Invert Sugar, Per Cent	Total Sugar, Per Cent.	Sucrose, Per Cent.
71.35	3.17	6.27	3.10	67.52	5.35	9.28	3.93	63.50	4.63	12.31	7.68

On comparing the results of the average analyses of the potatoes at different periods during storing, as determined by the Texas Station, we observe that the water content seems to decrease somewhat as the period of storage is extended. For instance, we find an average of 71.35 per cent. of water in the first lot of potatoes and 63.50 per cent. in the third and last lot of potatoes analyzed. This is a loss of 7.85 per cent., which is equivalent to about 11 per cent. of the total amount of water originally present. Considering the fact that a little over four months had elapsed between the time of the first and last analyses, we see that the loss of water sustained in these samples of potatoes on storing is by no means excessive. From this work, it appears further that the average percentages of invert sugar have increased somewhat in these samples of potatoes as the period of storing advances, though the increase is not regular. The fact is again brought out here that the sucrose (cane sugar) percentages increase regularly as the period of storing is extended. Unfortunately, in this work the starch percentages have not been determined. Consequently, we have no means by which we can compare the amount of starch actually lost by these samples on storing with the amount of the same, equivalent to the increase of sucrose (cane sugar) produced. Supposing, however, that the increase in sucrose content is due entirely to the decrease in starch content, we would expect in the above samples the following average loss of starch, as sustained during the entire period of storing. We will arrive at this loss of starch by the following equation:

$$\underset{\text{(Sucrose)}}{\overset{342.}{C_{12}H_{22}O_{11}}} : \underset{\text{(Starch)}}{\overset{324.}{2\,C_6H_{10}O_5}} = \underset{\text{(Gain in Sucrose)}}{4.58} : X$$

in which X will give us the starch percentage equivalent to 4.58 per cent. of sucrose, which is the amount of the latter (sucrose) gained as the result of storage. On solving this equation, we find X to be 4.34. That is to say, from these particular experiments, we would expect to find on an average the starch content decreased by 4.34 (four and thirty-four hundredths) per cent., as the result of stor-

age. These figures agree very well with those obtained in the preceding experiments and seem to confirm again the accuracy of the conclusions there drawn. The results of the particular experiment under consideration can be legitimately compared with those already noted because the period of storage was about the same, and, also, because in many cases the varieties of potatoes worked upon were identical. We pass next to the consideration of some experiments on the relative value of different methods of storing sweet potatoes. As is generally known and understood, the most serious problem which confronts those planting sweet potatoes, even for domestic purposes, is how to properly store them. This difficulty, of course, will be magnified when we come to consider the planting of the potatoes on a large scale for the production of starch in a commercial way. Many plans have been proposed for storing the sweet potato, but none as yet seems to have attracted any particular or exclusive favor. The most general plan for storing the sweet potato consists, as is generally known, in placing them in piles and covering with straw, then with cornstalks and then with dirt and lastly with a shelter of plank. We shall refer to this method as the one ordinarily used in practice. It is evident that that method of storing which will exclude moisture most effectively will prove most acceptable. It is an indispensable condition in the proper storing of the sweet potato that they should be put up in as dry a condition as possible and kept so. Excessive amounts of moisture favor very greatly the rapid decomposition of the potato.

III.

RELATIVE VALUE OF DIFFERENT METHODS OF STORING THE SWEET POTATO.

Five different methods of storing the potatoes were tried. They were as follows:

I. Stored in straw (broom) in a covered house.
II. Stored in sand in a covered house.
III. Stored in cotton seed hulls in a covered house.
IV. Stored in cotton seed in a covered house.
V. Stored in the ordinary way (in piles, covered with straw, corn stalks, dirt and a shelter of boards.)

The variety of potato used for this particular experiment was Georgia Buck. Immediately after the potatoes were harvested, which was done on November 7th, 1898, there was selected from the same five samples of as uniform appearance as possible, each weighing 400 pounds. These samples were then stored immediately according to the methods given above.

In order to get at the correct composition of the potato, as stored, a large composite sample was taken and analyzed as usual. The results of this analysis are given in the following table, which we will designate as No. XXIX:

TABLE XXIX.

ANALYSES OF POTATOES (GEORGIA BUCK) BEFORE STORING.

(November 28th, 1898.)

Original.				Air-dry.				Water-free.		
Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
75.35	13.13	0.77	4.31	6.79	49.65	2.93	16.31	53.27	3.14	17.50

As has been previously said, the samples for this particular storing test were taken out immediately from the potatoes as soon as they were harvested and were put up according to the different methods noted previously, on the following day, November 29th, 1898. The first samples for analysis were taken January 7th, 1899, a period of some 40 days having thus elapsed between the time at which these potatoes were first put up and the time at which the first analyses of the stored products were made. We consider in the next table (XXX) the analyses of the first lot of potatoes, stored by different methods, the samples of which were taken January 7th, 1899:

TABLE XXX.

ANALYSES OF FIRST LOT OF POTATOES, STORED BY DIFFERENT METHODS.

(January 7th, 1899.)

Method of Storing.	Original.				Air-dry.				Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
In straw, covered house...	73.59	7.20	3.46	7.51	8.80	24.87	11.96	25.95	27.27	13.11	28.45
In sand, covered house....	74.32	11.59	1.23	6.71	9.17	40.98	4.35	23.78	45.12	4.79	26.18
In c. s. hulls, covered house	72.81	12.99	1.41	6.02	9.45	43.26	4.71	20.05	47.77	5.20	22.14
In cott'n seed, cov'd house.	71.46	11.86	2.30	6.59	8.42	38.04	7.39	21.14	41.54	8.07	23.08
In usual way (straw, corn stalks, etc............	69.52	1351.	1.74	7.66	9.11	40.29	5.20	22.85	44.33	5.72	25.14

On comparing these figures with those in the preceding table (XXIX) we observe that up to the date on which the first lot of these potatoes, stored by different methods, was analyzed (January 7th, 1899), those put up in the usual way seem to have suffered least change in composition, while those stored in straw in a covered house seem to have experienced the greatest. We notice that storing the potatoes in cotton seed hulls and cotton seed, also in a covered house,

seem to have given very good results, the former method, however, being somewhat superior to the latter. Storing in sand in a covered house appears to have given about the same results as storing in cotton seed, though the results by the former practice are not quite so good as by the latter. Storing in straw seems to have given exceedingly unsatisfactory results. The actual loss of starch in the potatoes, stored in straw, during this period was 5.93 per cent., which is equivalent to 45.16 per cent. of the total starch originally present. This loss of starch is enormous, and, in so far as we may be justified in concluding from such few data, it appears very probable that the storing of sweet potatoes in straw is a questionable practice. After the sample of the potatoes, stored in straw, was taken for this analysis, it was observed that the rotting of those stored in this way which had already begun to a limited extent, soon became general and it was, therefore, impossible to do anything further with this particular lot. From what has been said, we observe that in so far as this particular period is concerned (November 28th, 1898, to January 7, 1899,) the method of storing in the usual way has given the best results, closely followed, however, by the method of storing in cotton seed hulls. These chemical results agree entirely with the results of a former practical test on this same subject made by Duggar at this Station (South Carolina Experiment Station, Bulletin 5, new series). His conclusions were that of all the materials tested for preserving the tubers, namely: sand, cotton seed, cotton hulls, damaged lint cotton, wheat bran, newspapers and hay, that the best results were obtained with dry sand and cotton seed hulls. Samples were again taken from the potatoes stored by the different methods on March 1st, 1899. As has been previously said, the potatoes stored in straw had by this time rotted to such an extent that it was impossible to do anything further with this particular lot. Analyses of the second lot of potatoes, stored by different methods, were now made with the following results. Table XXXI will give us this information.

TABLE XXXI.

ANALYSES OF SECOND LOT OF POTATOES, STORED BY DIFFERENT METHODS.

(March 1st, 1899.)

Method of Storing.	Original.				Air-dry.				Water-free.		
	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Water, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.	Starch, Per Cent.	Glucose, Per Cent.	Sucrose, Per Cent.
In sand, covered house....	73.97	9.07	1.33	7.98	7.21	32.34	4.73	28.44	34.85	5.10	30.65
In c. s. hulls, covered house	71.26	15.82	0.68	5.12	6.57	51.42	2.21	16.65	55.03	2.37	17.82
In cott'n seed, cov'd house.	69.68	15.68	0.55	6.04	6.05	48.57	1.72	18.72	51.70	1.83	19.93
In usual way (in straw, cornstalks, etc.).......	75.80	9.88	3.21	3.77	6.44	38.19	12.40	14.59	40.82	13.25	15.59

Comparing these results with those in Table XXIX, we observe that storing in cotton seed hulls, cotton seed and sand in the usual way continue to give the best results. Storing in straw has given the poorest results. From this work, it appears that cotton seed hulls are admirably adapted for use in storing sweet potatoes. The same is true for cotton seed, only to a less extent.

From the results of this work, the following general conclusions seem justified:

First. The quality of the sweet potato is sensibly affected by the form of potash used in fertilizing the same. For purposes of starch production, the use of potash in the form of sulphate or kainit is to be recommended. It appears probable from the work here reported that the use of potash in the form of muriate will likely be attended by unfavorable results.

Secondly. The storing of the sweet potato, even under the most favorable conditions, brings about profound changes in the chemical composition of the same. These changes are manifested by a decreased percentage of starch, accompanied by an increased percentage of sucrose (cane sugar). The amount of starch lost is generally speaking, equivalent to the amount of sucrose gained. In other words, it appears probable that the loss of starch is to be attributed in a large measure to a conversion of the same into sucrose (cane sugar). This change or conversion of starch into sucrose or cane sugar may be expressed by the following equation:

$$\underset{\text{(Starch)}}{2\,C_6H_{10}O_5} + \underset{\text{(Water)}}{H_2O} = \underset{\text{(Sucrose or cane sugar)}}{C_{12}H_{22}O_{11}}$$

As regards the glucose content, it appears probable that in the case of sweet potatoes, stored under proper conditions, there is no appreciable alteration in the same.

Third. The method by which the potato is stored is of great influence upon the rate and extent of the changes occurring in the same during storing. From these particular experiments, it would seem that the best results are to be obtained with the use of such materials as cotton seed hulls, dry sand and cotton seed in the order named. Storing in straw seems to be a questionable practice.

BULLETIN 64. JUNE, 1901.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

Analysis of Commercial Fertilizers

PART II.

Address all communications to

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ANALYSIS OF COMMERCIAL FERTILIZERS.

PART II.

Season of 1900-1901.

This bulletin completes the report of analyses of fertilizers for this season. Three hundred and thirty-five official samples have been collected and analyzed. One hundred and eighty-six analyses were reported in Bulletin No. 60, issued in April, and the analyses of one hundred and forty-nine are reported herein.

The commercial valuations of raw material for this season are as follows:

	Per Unit.	Per Pound.
Phosphoric Acid (available)............	$ .80	$.04
Ammonia in Sulp. Ammonia............	2.60	.13
Ammonia, Equiv. to Nitrogen, in Nit. Soda	2.40	.12
Ammonia, Equiv. to Nitrogen, in D. Blood	2.50	.12 1-2
Ammonia, Equiv. to Nitrog'n, in C.S. Meal	2.40	.12
Potash in Muriate of Potash............	.90	.04 1-2
Potash in Kainit......................	.90	.04 1-2
Potash in Sulphate of Potash............	1.00	.05

In mixed fertilizers the ingredients are reckoned as follows:

	Per Unit.	Per Pound.
Phosphoric Acid (available)............	$ .80	$.04
Ammonia	2.50	.12 1-2
Potash, Soluble in water................	.90	.04 1-2

For information in regard to the composition of commercial fertilizers, and the requirements of our State laws in the sale of commercial fertilizers, and the analysis of farmers' samples, see Bulletin No. 60, issued in April, 1901.

TABLE I.—Ammoniated Fertilizers.

Sample No.	Brand of Fertilizer.	Moisture.	FOUND. Phosphoric Acid. Total.	Insoluble.	Soluble.	Reverted.	Available.	Nitrogen.	Equivalent to Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	GUARANTEED. Available Phos. Acid.	Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer.	Manufactured at
278	Acme Am. Diss. Bone........	13.18	9.49	.64	6.82	2.03	8.85	2.14	2.60	1.38	14.82	8.00	2.50	1 00	13.55	Feb. 8	Yorkville.....	Acme Mfg. Co..........	Wilmington, N. C.
366	Armour's Gen. 2-8-2 Fert....	6.56	13.52	6.95	2.12	4.45	6.57	1.91	2.32	2.22	13.05	8.00	2.00	2.00	13.20	Feb. 25	Greenville....	Armour Fert. Works..	Baltimore, Md.
200	Ashley H. G. Tob. Fert.....	11.64	11.35	.87	8.67	1.81	10.48	2.92	3.55	4.14	20.99	8.00	4.00	4.00	20.00	Feb. 18	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.
426	Armour's Tob. Special......	9.13	11.66	3.31	3.14	5.21	8.35	2.89	3.51	3.34	18.46	8.00	3.00	3.00	16.60	May 25	Charleston....	Armour Fert. Works..	Baltimore, Md.
356	Armour's Gen. 2-8-2 Fert....	11.35	10.49	.97	5.16	4.36	9.52	1.88	2.28	2.06	15.17	8.50	2.00	2.00	13.60	Feb. 19	Mauldins......	Armour Fert. Works..	Baltimore, Md.
367	Armour's Tob. Special......	6.27	13.84	7.64	1.97	4.23	6.20	2.55	3.10	3.07	15.47	8.00	3.00	3.00	16.60	Feb. 25	Greenville....	Armour Fert. Works..	Baltimore, Md.
459	Ashepoo Tob. Fert...........	9.35	10.69	.87	8.33	1.49	9.82	3.48	4.23	4.21	22.22	8.00	4.00	4.00	20.00	Feb. 22	Society Hill..	Ashepoo Fert. Co......	Charleston, S. C.
476	Atlantic H. G. Sol. Guano..	14.03	10.18	1.07	5.90	3.21	9.11	1.71	2.08	2.30	14.56	8.50	2.00	2.00	13.60	Mar. 1	Latta..........	Atlantic Chem. Co.....	Norfolk, Va.
505	Augusta H. G. Guano.......	10.79	12.15	.42	7.79	3.94	11.73	2.11	2.56	2.34	17.89	9.50	2.50	2.00	15.65	Mar. 14	Millett........	Augusta Guano Co.....	Augusta, Ga.
149	African Cotton Grower......	6.44	15.26	7.12	2.80	5.34	8.14	3.06	3.72	2.92	18.44	9.00	3.00	3.00	17.40	Mar. 5	Fairfax.......	Armour Fert. Works..	Baltimore, Md.
524	Ashley Complete Fert........	11.08	10.98	2.10	5.91	2.97	8.88	2.40	2.91	2.02	16.20	8.00	2.50	1.00	13.55	Apr. 8	Springfield....	Va.-Carolina Chem. Co.	Charleston, S. C.
398	Anchor Brand Tob. Fert....	10.37	12.87	1.51	7.91	3.45	11.36	2.08	2.53	1.04	16.35	8.00	3.00	2.00	15.70	Apr. 9	Newberry.....	Va.-Carolina Chem. Co.	Charleston, S. C.
371	Blue Ridge Guano...........	10.96	9.20	.55	6.95	1.70	8.65	2.45	2.97	2.48	16.58	8.00	2.50	1.00	13.55	Feb. 28	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
487	Bone Guano..................	18.04	10.89	1.60	7.47	1.82	9.29	1.98	2.40	2.29	15.49	8.50	2.09	2.00	13.60	Mar. 8	Timmonsville.	Va.-Carolina Chem. Co.	Charleston, S. C.
382	Brock's Cotton Fert.........	11.01	9.70	.31	7.48	1.91	9.39	2.32	2.82	1.09	15.54	8.00	2.50	1.00	13.55	Mar. 16	Honea Path..	Brock Fert. Co..........	Honea Path, S. C.
274	Catawba Guano..............	7.68	8.37	.26	4.58	3.53	8.11	2.07	2.52	1.29	13.95	8.00	2.00	1.00	12.30	Feb. 4	Jonesville.....	Charlotte Oil & F't. Co.	Charlotte, N. C.
275	Charlotte Am. Fert..........	8.02	9.76	.65	5.91	3.20	9.11	2.17	2.63	1.82	15.50	8.00	2.50	1.50	14.00	Feb. 5	Gaffney.......	Charlotte Oil & F't. Co.	Charlotte, N. C.
469	Carolina Golden Belt Guano.	11.40	11.78	1.19	8.76	1.83	10.59	2.58	3.13	3.53	19.47	8.00	2.50	3.00	15.35	Feb. 27	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.
381	Coon's Delight Fert.........	10.89	10.04	.55	7.33	2.16	9.49	1.84	2.24	.62	13.75	8.00	2.00	.....	11.40	Mar. 16	Honea Path...	Brock Fert. Co.........	Honea Path, S. C.
299	Cherokee H. G. Amm. Fert.	12.03	10.11	.74	6.87	2.50	9.37	2.09	2.54	1.27	14.99	8.00	2.50	1.00	13.55	Mar. 2	Gaffney.......	Va.-Carolina Chem. Co.	Charleston, S. C.
393	Conneross Guano............	11.53	9.83	.18	8.34	1.31	9.65	1.74	2.11	2.03	14.82	8.50	2.00	2.00	13.60	Mar. 29	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
377	Cinco Tobacco Guano.......	9.62	10.54	1.42	5.22	3.90	9.12	2.17	2.63	2.97	16.54	8.50	2.50	2.50	15.30	Mar. 13	Little Mount'n	Pocomoke Guano Co...	Norfolk, Va.
621	Chicora Special Tob. Fert...	6.73	11.97	.46	8.99	2.52	11.51	2.96	3.60	3.06	20.96	8.00	4.00	4.00	20.00	Mar. 27	Marion.......	Va.-Carolina Chem. Co.	Charleston, S. C.
365	Durham B. & Peruv. G'no.	15.43	12.46	.93	6.43	5.10	11.53	1.68	2.04	2.06	16.18	8.50	2.00	2.00	13.60	Feb. 23	Wellford.	Va.-Carolina Chem. Co.	Charleston, S. C.
364	Durham Amm. Fert.........	15.01	12.61	.95	7.09	4.57	11.66	1.75	2.12	1.42	15.91	8.00	2.00	1.00	12.30	Feb. 23	Wellford.	Va.-Carolina Chem. Co.	Charleston, S. C.
142	Eutaw Guano	13.80	10.81	1.56	6.05	3.20	9.25	2.16	2.62	1.32	15.14	8.00	2.50	1.00	13.55	Feb. 20	Creston.......	Ashepoo Fert. Co......	Charleston, S. C.
150	Fert. "272"..................	4.60	11.18	1.15	1.93	8.10	10.03	2.22	2.70	2.27	16.82	7.00	2.00	2.00	12.40	Mar. 12	Cohens Bluff.	Armour Fert. Works..	Kas. City, U. S. A.
378	Farmers' Amm. Phos........	11.48	11.54	2.88	7.84	.82	8.66	1.89	2.30	2.70	15.11	8.00	2.15	2.00	13.57	Mar. 15	Prosperity....	G. Ober & Sons.........	Baltimore, Md.

TABLE I.—Ammoniated Fertilizers.—Continued.

Sample No.	Brand of Fertilizer.	Moisture.	FOUND. Phosphoric Acid. Total.	Insoluble.	Soluble.	Reverted.	Available.	Nitrogen.	Equivalent to Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	GUARANTEED. Available Phos. Acid.	Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer.	Manufactured at
360	Gosnell's Plant Food.........	9.27	12.77	.68	8.93	3.16	12.09	2.48	3.01	2.36	19.32	10.00	3.00	2.00	17.30	Feb. 22	Spartanburg..	Spartanburg Fert. Co..	Spartanburg, S. C.
370	"G. W. G." Soluble Guano.	10.88	9.17	.64	7.02	1.51	8.53	2.44	2.96	2.00	16.02	8.00	2.50	1.00	13.55	Feb. 28	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
300	Gem Fertilizer	12.34	9.77	.26	7.79	1.72	9.51	2.21	2.69	2.14	16.26	8.50	2.00	2.00	13.60	Mar. 3	Gaffney.......	Acme Mfg. Co.........	Wilmington, N. C.
194	Golden Leaf Tob. Producer.	10.28	10.90	1.43	7.62	1.85	9.47	2.49	3.02	3.15	17.96	8.00	3.00	3.00	16.60	Feb. 15	Hartsville.....	Ashepoo Fert. Co......	Charleston, S. C.
135	H. G. Truck Guano.........	8.19	9.35	1.39	4.91	3.05	7.96	6.28	7.62	5.46	30.33	7.00	8.00	5.00	30.10	Feb. 9	Youngs Island	Lazaretto Guano Co...	Baltimore, Md.
497	"I. X. L." Tob. Fert........	12.32	12.26	2.52	7.69	2.05	9.74	2.49	3.03	3.01	18.08	8.00	3.00	3.00	16.60	Mar. 15	Hartsville.....	Va.-Carolina Chem. Co.	Charleston, S. C.
296	King Cotton Grower........	8.06	8.17	.28	6.06	1.83	7.89	2.06	2.50	2.25	14.59	8.00	2.00	2.00	13.20	Feb. 25	Rock Hill.....	Charlotte Oil & F't. Co.	Charlotte, N. C.
391	Keowee Guano..............	14.86	10.63	.42	8.17	2.04	10.21	1.05	1.28	2.49	13.61	9.00	1.00	2.00	11.50	Mar. 27	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
628	King Cotton Fert............	16.44	12.82	2.35	6.83	3.64	10.47	1.09	1.32	1.81	13.31	10.00	1.00	1.00	11.40	Apl. 3	Manning......	Va.-Carolina Chem. Co.	Charleston, S. C.
504	Leffler's Am. Diss. Bone....	14.00	11.83	1.71	6.98	3.14	10.12	2.17	2.63	2.00	16.47	8.00	2.00	2.00	13.20	Mar. 12	Cohens Bluff.	Va.-Carolina Chem. Co.	Charleston, S. C.
146	Melon Fert..................	10.44	11.44	.81	8.72	1.91	10.63	3.66	4.45	5.61	24.68	10.00	4.00	5.00	22.50	Feb. 25	Appleton......	Lazaretto Guano Co...	Baltimore, Md.
456	Monarch Tob. Grower.......	10.98	10.18	1.28	6.04	2.86	8.90	2.47	3.00	3.37	17.65	8.00	3.00	3.00	16.60	Feb. 22	Society Hill..	Pocomoke Guano Co...	Norfolk, Va.
394	Marett Sol. Guano...........	11.79	9.85	.15	8.55	1.15	9.70	1.77	2.15	2.64	15.51	8.50	2.00	2.00	13.60	Mar. 29	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
615	Manure Substitute...........	6.19	11.63	6.01	1.04	4.58	5.62	3.37	4.09	4.29	18.58	6.00	4.00	4.00	18.40	Mar. 26	Mullins.......	Armour Fert. Works..	Baltimore, Md.
376	Obers Am. Diss. Bone......	11.27	11.80	.92	9.38	1.50	10.88	1.90	2.31	2.91	17.10	8.00	2.00	2.00	13.20	Mar. 13	Clinton.......	G. Ober & Sons Co....	Baltimore, Md.
612	Obers Special Tob. Phos....	11.36	12.37	2.99	8.25	1.13	9.38	2.55	3.10	3.03	17.98	8.00	3.00	3.00	16.60	Mar. 23	Lamar........	G. Ober & Sons Co....	Baltimore, Md.
388	Old Hickory Guano..........	9.35	13.77	4.66	3.65	5.46	9.11	2.70	3.28	1.20	16.57	8.00	2.50	1.00	13.55	Mar. 26	Greers........	Va.-Carolina Chem. Co.	Charleston, S. C.
285	Old Hickory Guano..........	10.76	9.26	.78	5.88	2.60	8.48	2.04	2.48	1.28	14.14	8.00	2.50	1.00	13.55	Feb. 14	Fort Lawn....	Va.-Carolina Chem. Co.	Charleston, S. C.
276	P., G. & Co's H.G. Am. G'no	12.76	10.20	.73	7.37	2.10	9.47	2.17	2.63	1.32	15.34	8.00	2.50	1.00	13.55	Feb. 6	Gaffney.......	Va.-Carolina Chem. Co.	Charleston, S. C.
425	P., G. & Co's H.G. Am. G'no	13.74	11.99	2.28	6.40	3.31	9.71	1.82	2.21	2.18	15.26	8.50	2.00	2.00	13.60	Apl. 19	Lancaster.....	Va.-Carolina Chem. Co.	Charleston, S. C.
244	Patapsco Am. Diss. Bone....	12.54	10.96	1.57	6.93	2.46	9.39	2.04	2.48	1.31	14.89	8.00	2.50	1.00	13.55	Feb. 13	Parksville.....	Ga. Chem. Works......	Augusta, Ga.
148	P. & F. Amm. Fert..........	12.74	9.36	.28	7.24	1.84	9.08	1.98	2.41	2.90	15.90	8.50	2.00	2.00	13.60	Mar. 1	Ellenton......	Augusta Guano Co.....	Augusta, Ga.
420	P. C. Co.'s "Hustler".......	11.40	10.57	1.47	5.67	3.43	9.10	2.09	2.54	3.03	16.36	8.00	3.00	3.00	16.60	Apr. 5	Gaffney.......	Richmond Guano Co...	Richmond, Va.
384	Royal Soluble Guano........	10.97	12.49	2.57	6.45	3.47	9.92	1.65	2.01	1.45	14.27	8.00	2.00	1.00	12.30	Mar. 23	Anderson.....	Va.-Carolina Chem. Co.	Charleston, S. C.
495	Rose Hill Guano............	13.74	10.85	1.62	6.49	2.74	9.23	2.31	2.81	1.37	15.64	8.00	2.50	1.00	13.55	Mar. 13	Sumter........	Ashepoo Fert. Co......	Charleston, S. C.
489	Read's Tob. Leaf...........	12.39	9.80	1.02	6.31	2.47	8.78	2.92	3.54	3.42	18.95	8.00	3.00	3.00	16.60	Mar. 8	Timmonsville.	Read Phos. Co.........	Charleston, S. C.

TABLE I.—Ammoniated Fertilizers.—Concluded.

Sample No.	Brand of Fertilizer.	Moisture.	FOUND.									GUARANTEED.				Date Sampled.	Sampled at	Manufaturer.	Manufactured at
			Phosphoric Acid.																
			Total.	Insoluble.	Soluble.	Reverted.	Available.	Nitrogen.	Equivalent to Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Available Phos. Acid.	Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.				
136	Read's H. G. Truck Fert....	10.18	8.60	.96	4.07	3.57	7.64	6.67	8.10	4.75	30.64	7.00	8.00	5.00	30.10	Feb. 9	Youngs Island	Read Phos. Co.........	Charleston, S. C.
486	Read's Tob. Leaf............	12.41	10.16	.95	6.55	2.66	9.21	2.54	3.08	2.48	17.30	8.00	3.00	2.00	15.70	Mar. 7	Dillon.........	Read Phos. Co.........	Charleston, S. C.
498	Raw Bone Super-Phos.......	9.96	13.87	4.08	5.92	3.87	9.79	1.97	2.39	.93	14.64	8.00	2.50	1.00	13.55	Mar. 15	Hartsville.....	Etiwan Fert. Co.........	Charleston, S. C.
501	Sea Fowl Guano............	12.63	11.85	1.73	7.29	2.83	10.12	1.94	2.36	1.57	15.41	9.00	2.25	1.00	13.72	Mar. 12	Cohens Bluff.	Bradley Fert. Co......	Boston, Mass.
513	Stonewall Guano............	15.61	12.08	1.45	8.43	2.20	10.63	1.93	2.35	2.44	16.58	8.50	2.00	2.00	13.60	Mar. 18	Johnston......	Va.-Carolina Chem. Co.	Charleston, S. C.
517	Stono H. G. Tob. Fert.,....	10.56	10.81	.74	7.92	2.15	10.07	3.35	4.07	4.08	21.90	8.00	4.00	4.00	20.00	Mar. 21	Allendale.....	Va.-Carolina Chem. Co.	Charleston, S. C.
416	Star Brand Guano..........	11.70	10.08	.92	6.70	2.46	9.16	1.98	2.41	2.32	15.44	8.50	2.00	2.00	13.60	Apr. 4	Cowpens......	Va.-Carolina Chem. Co.	Charleston, S. C.
392	Seneca H. G. Guano........	10.52	10.39	.74	7.71	1.94	9.65	2.03	2.47	1.48	15.23	8.00	2.50	1.00	13.55	Mar. 29	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
357	Tiger Brand Boll Buster....	8.28	10.54	.26	7.57	2.71	10.28	1.76	2.14	2.33	15.67	8.50	2.00	2.00	13.60	Feb. 22	Spartanburg..	Spartanburg Fert. Co..	Spartanburg, S. C.
499	Tobacco Guano..............	12.67	11.50	2.66	6.98	1.86	8.84	2.46	2.99	1.77	16.14	8.00	2.50	2.00	14.45	Mar. 15	Hartsville.....	Navassa Guano Co....	Wilmington, N. C.
197	Wagener's H. G. Am. Fert..	18.83	11.62	2.75	5.62	3.25	8.87	2.64	3.21	1.83	16.77	8.00	2.50	1.00	13.55	Feb. 18	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.

TABLE II---Acid Phosphates Without Potash.

			FOUND.									GUARANTEED.							
			Phosphoric Acid.																
Sample No.	Brand of Fertilizer.	Moisture.	Total.	Insoluble.	Soluble.	Reverted.	Available.	Nitrogen.	Equivalent to Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Available Phos. Acid.	Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer.	Manufactured at
606	Allison & Addison Dis. Bone	12.53	14.93	.79	11.56	2.58	14.14	....	....	....	11.31	13.00	....	....	10.40	Mar. 21	Cheraw.......	Va.-Carolina Chem. Co.	Charleston, S. C.
368	Armour's Acid Phos........	8.71	16.04	1.64	2.83	11.57	14.40	....	....	....	11.52	13.00	....	....	10.40	Feb. 25	Greenville....	Armour Fert. Works..	Baltimore, Md.
387	Armour's Star Phos. Fert..	12.36	17.81	3.16	10.32	4.33	14.65	....	....	....	11.72	14.00	....	....	11.20	Mar. 26	Greers........	Armour Fert. Works..	Anderson, S. C.
526	Anderson Super-Phos.......	5.02	19.95	1.55	14.99	3.41	18.40	....	....	....	14.72	16.00	....	....	12.80	Apr. 15	Anderson.....	Anderson Fert. Co.....	Anderson, S. C.
396	Anderson Super-Phos.......	14.85	16.74	2.35	9.20	5.19	14.39	....	....	....	11.51	16.00	....	....	12.80	Apr. 1	Anderson.....	Anderson Fert. Co.....	Anderson, S. C.
215	Anderson Super-Phos.......	14.04	17.48	3.65	9.31	4.52	13.83	....	....	....	11.06	16.00	....	....	12.80	Feb. 2	Anderson.....	Anderson Fert. Co.....	Anderson, S. C.
622	Berkeley Diss. Bone........	18.54	13.78	.55	11.17	2.06	13.23	....	....	....	10.58	13.00	....	....	10.40	Mar. 28	McColl........	Va.-Carolina Chem. Co.	Charleston, S. C.
511	Bradley's XXX Acid Phos..	10.40	15.88	1.14	11.86	2.88	14.74	....	....	....	11.79	13.00	....	....	10.40	Mar. 18	Leesville......	Bradley Fert. Co......	Charleston, S. C.
472	Berkeley Acid Phos.........	14.27	14.71	1.22	10.57	2.92	13.49	....	....	....	10.79	12.00	....	....	9.60	Feb. 28	Elliott.........	Berkeley Fert. Co......	Charleston, S. C.
383	Cherokee Diss. Bone........	13.39	14.00	1.00	11.08	1.92	13.00	....	....	....	10.40	12.00	....	....	9.60	Mar. 23	Anderson.....	Va.-Carolina Chem. Co.	Charleston, S. C.
352	Diss. Bone Phos.............	15.05	14.06	2.03	9.16	2.87	12.03	....	....	....	9.62	13.00	....	....	10.40	Feb. 18	Piedmont.....	Ga. Chem. Works......	Augusta, Ga.
143	Diamond Soluble Bone......	12.33	15.70	3.24	6.63	5.83	12.46	....	....	....	9.97	13.00	....	....	10.40	Feb. 20	Creston.......	Etiwan Fert. Co.......	Charleston, S. C.
198	Darlington Acid Phos.......	15.53	14.71	1.16	9.85	3.70	13.55	....	....	....	10.84	12.00	....	....	9.60	Feb. 18	Darlington....	Pee Dee Oil & Ice Co.	Darlington, S. C.
454	Edisto Diss. Bone...........	11.16	15.96	2.16	11.27	2.53	13.80	....	....	....	11.04	12.00	....	....	9.60	Feb. 18	Cheraw.......	Va.-Carolina Chem. Co.	Charleston, S. C.
250	Eutaw XX Acid Phos......	7.58	15.25	.68	10.62	3.95	14.57	....	....	....	11.66	12.00	....	....	9.60	Feb. 16	Williamston..	Ashepoo Fert. Co......	Charleston, S. C.
191	Game Cock Diss. Bone......	11.78	14.94	1.93	10.95	2.06	13.01	....	....	....	10.41	13.00	....	....	10.40	Feb. 15	Hartsville.....	Va.-Carolina Chem. Co.	Charleston, S. C.
379	H. G. Acid Phos............	11.42	15.00	2.20	10.18	2.62	12.80	....	....	....	10.24	13.00	....	....	10.40	Mar. 16	Greenwood...	American Fertilizing Co	Norfolk, Va.
412	H. G. Acid Phos............	13.24	14.86	1.15	11.12	2.59	13.71	....	....	....	10.97	14.00	....	....	11.20	Mar. 22	Camden.......	American Fertilizing Co	Norfolk, Va.
611	Navassa Diss. Bone.........	14.13	14.87	2.69	10.17	2.01	12.18	....	....	....	9.74	12.00	....	....	9.60	Mar. 22	Cheraw.......	Navassa Guano Co.....	Wilmington, N. C.
452	Red Bull Diss. Bone........	11.38	15.01	1.29	10.84	2.88	13.72	....	....	....	10.98	13.00	....	....	10.40	Feb. 18	Cheraw.......	Va.-Carolina Chem. Co.	Charleston, S. C.
395	Seneca H. G. Acid Phos....	12.57	15.74	1.51	11.62	2.61	14.23	....	....	....	11.38	13.00	....	....	10.40	Mar. 29	Seneca........	Seneca Fert. Co.......	Seneca, S. C.
500	Stono Diss. Bone..........	16.58	15.42	.38	12.22	2.82	15.04	....	....	....	12.03	13.00	....	....	10.40	Mar. 18	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.
359	Tiger Brand Diss. Bone....	8.56	16.48	.35	12.08	4.05	16.13	....	....	....	12.90	13.00	....	....	10.40	Feb. 22	Spartanburg..	Spartanburg Fert. Co..	Spartanburg, S. C.
604	Wagener's Diss. Bone......	14.80	14.10	.49	10.49	3.12	13.61	....	....	....	10.89	13.00	....	....	10.40	Mar. 2	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.
470	Wando Diss. Bone..........	12.04	16.00	1.36	11.85	2.79	14.64	....	....	....	11.71	13.00	....	....	10.40	Feb. 27	Darlington....	Va.-Carolina Chem. Co.	Charleston, S. C.
354	Virginia Diss. Bone.........	12.55	13.66	.78	7.04	5.84	12.88	....	....	....	10.30	12.00	....	....	9.60	Feb. 19	Mauldins.....	Richmond Guano Co..	Richmond, Va.
351	Diss. Bone Phos............	13.20	14.73	1.61	9.65	3.47	13.12	....	....	....	10.50	13.00	....	....	10.40	Feb. 18	Piedmont.....	Ga. Chem. Works......	Augusta, Ga.
463	Diamond Sol. Bone.........	12.58	15.64	2.11	8.21	5.32	13.53	....	....	....	10.82	13.00	....	....	10.40	Feb. 25	Bennettsville.	Etiwan Fert. Co.......	Charleston, S. C.

TABLE III—Acid Phosphates With Potash.

Sample No.	Brand of Fertilizer.	Moisture.	Found. Phosphoric Acid. Total.	Insoluble.	Soluble.	Reverted.	Available.	Nitrogen.	Equivalent to Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Guaranteed. Available Phos. Acid.	Ammonia.	Potash Soluble in Water.	Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer.	Manufactured at
277	Alkali Bone..................	13.49	11.90	.83	6.35	4.72	11.07	....	....	2.26	10.89	11.00	....	2.00	10.60	Feb. 6	Gaffney.......	Pocomoke Guano Co..	Norfolk, Va.
355	Armour's Phos. & Pot......	10.55	11.56	.77	2.58	8.21	10.79	....	....	2.49	10.87	10.00	....	2.00	9.80	Feb. 19	Mauldins.....	Armour Fert. Works..	Baltimore, Md.
292	Acid Phos. with Pot........	11.85	13.55	2.00	5.36	6.19	11.55	....	....	2.03	11.07	10.00	....	2.00	9.80	Feb. 21	Kershaw......	Va.-Carolina Chem. Co.	Charleston, S. C.
372	Anderson XX Pot. Bone....	13.48	12.90	2.16	6.58	4.16	10.74	....	....	2.00	10.39	10.00	....	2.00	9.80	Mar. 4	Anderson.....	Anderson Fert. Co.....	Anderson, S. C.
405	Acme Bone and Potash.....	13.93	12.20	.23	9.95	2.02	11.97	....	....	3.81	13.01	10.00	....	3.00	10.70	Mar. 14	Knox Station.	Acme Mfg. Co........	Wilmington, N. C.
509	Alkali Bone..................	15.15	13.53	2.24	11.14	.15	11.29	....	....	2.28	11.08	11.00	....	2.00	10.60	Mar. 15	Johnston......	Pocomoke Guano Co..	Norfolk, Va.
492	Acid Phos. and Potash......	16.57	12.55	.45	9.85	2.25	12.10	....	....	1.52	11.05	12.00	....	1.00	10.50	Mar. 13	Sumter.......	W. C. Macmurphy Co.	Charleston, S. C.
605	Allison & Addison Ac. Phos.	12.05	12.84	1.23	8.72	2.89	11.61	....	....	2.89	11.89	10.00	....	2.00	9.80	Mar. 21	Cheraw.......	Va.-Carolina Chem. Co.	Charleston, S. C.
280	Acme Diss. Bone............	12.68	11.16	.77	7.74	2.65	10.39	....	....	4.69	12.53	10.00	....	3.00	10.70	Feb. 11	Chester.......	Acme Mfg. Co.......	Wilmington, N. C.
515	Bone and Potash............	11.60	13.65	1.38	8.01	4.26	12.27	....	....	2.42	11.99	10.00	....	2.00	9.80	Mar. 21	Allendale.....	Ga. Chem. Works.....	Augusta, Ga.
406	Bone and Potash............	11.27	10.72	.12	5.60	5.00	10.60	....	....	1.82	10.12	10.00	....	2.00	9.80	Mar. 16	Blackstock....	Charlotte Oil & F't. Co	Charlotte, N. C.
496	Chicora Ac. Phos. with Pot.	14.63	13.07	.93	9.74	2.40	12.14	....	....	1.92	11.44	10.00	....	2.00	9.80	Mar. 14	Mayesville....	Va.-Carolina Chem. Co	Charleston, S. C.
291	Chic. Ac. Ph. with Pot, (10-4)	10.39	13.02	2.88	2.87	7.27	10.14	....	....	5.07	12.68	10.00	....	4.00	11.60	Feb. 21	Kershaw......	Va.-Carolina Chem. Co.	Charleston, S. C.
245	Chic. Ac. Ph. with Pot. (8-4)	11.92	12.41	2.02	7.18	3.21	10.39	....	....	3.37	11.35	8.00	....	4.00	10.00	Feb. 14	Bordeaux.....	Va.-Carolina Chem. Co	Charleston, S. C.
362	Durham Ac. Phos. with Pot.	13.93	15.33	1.04	8.28	6.01	14.29	....	....	2.40	13.59	10.00	....	2.00	9.80	Feb. 2	Wellford......	Va.-Carolina Chem. Co	Charleston, S. C.
380	Diss. Bone & Pot. Guano...	11.94	12.33	1.94	4.41	5.98	10.39	....	....	2.14	10.24	10.00	....	2.00	9.80	Mar. 16	Greenwood...	American Fertilizing Co	Norfolk, Va.
473	Edisto Acid Phos. with Pot.	15.77	10.63	.90	7.56	2.17	9.73	....	....	3.24	10.70	10.00	....	2.00	9.80	Feb. 28	Bishopville....	Va.-Carolina Chem. Co	Charleston, S. C.
525	Etiwan Pot. Bone...........	12.16	11.18	1.61	4.76	4.81	9.57	....	....	3.57	10.87	10.00	....	4.00	11.60	Apr. 12	Cave..........	Etiwan Fert. Co.......	Charleston, S. C.
195	Etiwan Special Pot. Mix...	10.38	11.71	2.49	1.66	7.56	9.22	....	....	3.15	10.21	8.00	....	4.00	10.00	Feb. 15	Hartsville.....	Etiwan Fert. Co.......	Charleston, S. C.
183	Plow Bd. Ac. Ph. with Pot.	14.18	13.80	2.00	8.17	3.63	11.80	....	....	1.55	10.84	11.00	....	1.00	9.70	Feb. 13	Georgetown...	Etiwan Fert. Co.......	Charleston, S. C.
424	Leroy Springs' Acid Phos..	15.62	12.58	.41	9.68	2.49	12.17	....	....	3.81	13.17	10.00	....	4.00	11.60	Apr. 19	Lancaster.....	Va.-Carolina Chem. Co	Charleston, S. C.
502	Peruvian Bone Compound..	14.73	9.16	.73	6.32	2.11	8.43	....	....	3.16	9.59	8.00	....	4.00	10.00	Mar. 12	Cohens Bluff.	Va.-Carolina Chem. Co	Charleston, S. C.
369	Seneca H. G. Acid Phos....	12.15	11.53	.77	8.23	2.53	10.76	....	....	2.35	10.72	10.00	....	2.00	9.80	Feb. 28	Seneca.........	Seneca Fert. Co.......	Seneca, S. C.
462	Stono Acid Phos. with Pot.	14.94	12.91	.42	11.01	1.48	12.49	....	....	2.64	12.37	10.00	....	4.00	11.60	Feb. 25	Bennettsville.	Va.-Carolina Chem. Co	Charleston, S. C.
361	Tiger Brand West Pot. Acid	9.34	15.42	.46	11.04	3.92	14.96	....	....	3.21	14.86	12.00	....	3.00	12.30	Feb. 22	Spartanburg..	Spartanburg Fert. Co..	Spartanburg, S. C.

TABLE IV—Cotton Seed Meals.

Sample No.	Manufacturer.	Moisture.	Found. Phosphoric Acid. Total.	Found. Phosphoric Acid. Insoluble.	Found. Phosphoric Acid. Soluble.	Found. Phosphoric Acid. Reverted.	Found. Phosphoric Acid. Available.	Found. Nitrogen.	Found. Equivalent to Ammonia.	Found. Potash Soluble in Water.	Found. Relative Com. Val. per Ton.	Guaranteed. Available Phos. Acid.	Guaranteed. Ammonia.	Guaranteed. Potash Soluble in Water.	Guaranteed. Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer.	Manufactured at
404	Chester Oil Mill.............	7.38	2.64	.14	1.02	1.48	2.50	7.37	8.95	1.52	24.85	1.50	7.50	1.00	19.10	Mar. 11	Chester.......	Chester Oil Mill.......	Chester, S. C.
480	Darlington Oil Mill..........	5.28	3.13	.22	1.29	1.62	2.91	7.31	8.88	1.60	25.08	.....	8.00	.....	19.20	Mar. 6	Darlington....	Darlington Oil Mill....	Darlington, S. C.
478	Dillon Cotton Seed Oil Mill.	4.93	2.76	.18	1.36	1.22	2.58	6.75	8.20	1.47	23.07	.....	7.50	.....	18.00	Mar. 1	Latta.........	Dillon C. S. Oil Mill..	Dillon, S. C.
461	Elberton Oil Mill.............	6.03	2.58	.19	1.19	1.20	2.39	7.07	8.59	1.64	24.00	.....	8.00	.....	19.20	Feb. 26	Bennettsville.	Elberton Oil Mill......	Elberton, Ga.
353	Farmers Oil Mill.............	7.33	2.33	.12	1.01	1.20	2.21	6.75	8.20	1.60	22.89	.....	7.50	.....	18.00	Feb. 18	Greenville....	Farmers Oil Mill......	Greenville, S. C.
189	Hartsville Oil Mill..........	6.34	2.81	.19	1.16	1.46	2.62	7.09	8.61	1.65	24.25	.....	7.50	.....	18.00	Feb. 15	Hartsville.....	Hartsville Oil Mill.....	Hartsville, S. C.
503	Inter-State Cotton Oil Co....	7.59	2.46	.19	1.10	1.17	2.27	6.41	7.78	1.67	21.99	.....	7.50	.....	18.00	Mar. 12	Cohens Bluff.	Inter-State C'n Oil Co.	Augusta, Ga.
631	Manning Oil Mill and Ice Co	7.10	2.56	.15	1.05	1.36	2.41	6.80	8.33	1.61	23.37	1.50	6.50	1.00	16.70	Apr. 3	Manning......	Manning O. M. & Ice Co	Manning, S. C.
460	Pee Dee Oil and Ice Co.....	6.76	3.10	.19	1.27	1.64	2.91	7.45	9.05	1.56	25.45	2.00	8.00	1.00	21.70	Feb. 23	Darlington....	Pee Dee Oil & Ice Co..	Darlington, S. C.
397	Victor Cotton Oil Co.........	7.09	2.79	.20	1.07	1.52	2.59	7.41	9.00	1.63	25.14	.....	7.50	.....	18.00	Apr. 2	Cl'ms'n Col'ge	Victor Cotton Oil Co..	Gaffney, S. C.
419	Victor Cotton Oil Co.........	6.57	2.53	.17	1.18	1.18	2.36	7.67	9.31	1.63	25.70	1.50	7.50	1.00	19.10	Apr. 5	Gaffney.......	Victor Cotton Oil Co..	Gaffney, S. C.
187	Florence Oil Mill.............	6.69	2.90	.14	1.04	1.72	2.76	7.13	8.66	1.62	24.45	.....	7.00	.....	16.80	Feb. 14	Florence......	Florence Oil Mill......	Florence, S. C.
423	Concord Cotton Seed Oil Mill	4.18	2.57	.19	1.16	1.22	2.38	8.27	10.04	1.56	27.40	1.50	7.50	1.00	19.10	Apr. 13	Rock Hill.....	Concord C. S. Oil Mill.	Concord, N. C.

TABLE V—Kainits.

Sample No.	Importer or Dealer.	Found.		Guaranteed.		Date Sampled.	Sampled at	Importer or Dealer.	Address.
		Potash Soluble in Water.	Relative Com. Val. per Ton.	Potash Soluble in Water.	Relative Com. Val. per Ton.				
408	Acme Manufacturing Co......	12.35	11.12	12.00	10.80	Mar. 18	Chester............	Acme Manufacturing Company..	Wilmington, N. C.
375	Armour Fertilizer Works.....	12.24	11.02	12.00	10.80	Mar. 12	Greenville.........	Armour Fertilizer Works........	Baltimore, Md.
192	J. L. Coker & Co..............	12.76	11.48	13.00	11.70	Feb. 15.	Hartsville..........	J. L. Coker & Co.................	Hartsville, S. C.
519	Etiwan Fertilizer Co..........	13.05	11.75	12.00	10.80	Mar. 23	Orangeburg........	Etiwan Fertilizer Company.......	Charleston, S. C.
464	E. Sternberger	14.15	12.74	13.00	11.70	Feb. 26	Tatum.............	E. Sternberger....................	Clio, S. C.

TABLE VI—Miscellaneous Samples.

Sample No.	Brand of Fertilizer.	Moisture.	Found. Phosphoric Acid. Total.	Found. Phosphoric Acid. Insoluble.	Found. Phosphoric Acid. Soluble.	Found. Phosphoric Acid. Reverted.	Found. Phosphoric Acid. Available.	Found. Nitrogen.	Found. Equivalent to Ammonia.	Found. Potash Soluble in Water.	Found. Relative Com. Val. per Ton.	Guaranteed. Available Phos. Acid.	Guaranteed. Ammonia.	Guaranteed. Potash Soluble in Water.	Guaranteed. Relative Com. Val. per Ton.	Date Sampled.	Sampled at	Manufacturer or Importer.	Manufactured at or Address.
624	Nitrate of Soda..............	....	.....	....	....	....	....	15.52	18.86	.....	45.26	....	18.00	.....	43.20	Mar. 29	Bennettsville.	Alfred S. Malcerson...	New York, N. Y.
479	Nitrate of Soda..............	....	.....	....	....	....	....	15.81	19.21	.....	46.10	....	18.00	.....	43.20	Mar. 2	Darlington....	W. R. Grace...........	New York, N. Y.
193	Nitrate of Soda..............	....	.....	....	....	....	....	15.48	18.82	.....	45.17	....	18.00	.....	43.20	Feb. 15	Hartsville.....	Ashepoo Fert. Co......	Charleston, S. C.
138	Muriate of Potash...........	2.53	.....	....	....	....	....	.....	.....	49.69	44.72	....	.....	50.00	45.00	Feb. 9	Youngs Island	Ashepoo Fert. Co......	Charleston, S. C.
481	Muriate of Potash...........	....	.....	....	....	....	....	.....	.....	48.14	43.33	....	.....	48.00	43.20	Mar. 7	Dillon.........	W. C. Macmurphy Co.	Charleston, S. C.
620	Sulphate of Potash..........	....	.....	....	....	....	....	.....	.....	50.36	50.36	....	.....	48.00	48.00	Mar. 27	Marion........	Va.-Carolina Chem. Co.	Charleston, S. C.
629	Sulphate of Potash..........	....	.....	....	....	....	....	.....	.....	48.50	48.50	....	.....	45.00	45.00	Apr. 3	Manning......	Ashepoo Fert. Co......	Charleston, S. C.
627	Ash Element..................	5.97	9.72	.95	.82	7.95	8.77	.....	.....	3.10	9.81	6.00	.....	2.50	6.25	Apr. 3	Manning......	Ashepoo Fert. Co......	Charleston, S. C.
402	Cerealite Top Dressing.......	....	.....	....	....	....	....	7.51	9.12	2.77	25.29	....	9.00	2.50	24.75	Mar. 4	Chester.......	Home Fert. Chm. Wks.	Baltimore, Md.
491	Lee's Prepared Ag'l Lime...	....	.....	....	....	....	....	.....	.....	2.36	2.12	....	.....	2.00	1.80	Mar. 3	Timmonsville.	A. S. Lee & Son.......	Richmond, Va.
619	Manure Salt..................	....	.....	....	....	....	....	.....	.....	21.60	19.44	....	.....	20.00	18.00	Mar. 27	Marion........	Va.-Carolina Chem. Co.	Charleston, S. C.
137	Tankage	5.42	13.77	6.40	0.00	7.37	7.37	6.34	7.70	.26	23.60	....	8.00	.....	.....	Feb. 9	Youngs Island	Armour Packing Co...	Kas. City, U. S. A.
485	Tankage "H. G."..........	4.97	13.52	5.78	0.17	7.57	7.74	7.35	8.92	.19	26.43	....	8.00	.....	.....	Mar. 7	Dillon.........	Armour Packing Co...	Kas. City, U. S. A.

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South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

SAN JOSE SCALE,

With a Few Suggestions for Its Treatment,

AND

Rules and Regulations Adopted by State Board of Entomology.

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THE SAN JOSE SCALE,

With a Few Suggestions for Its Treatment.

Ever since the discovery of the San Jose' scale in the eastern part of the United States, in 1893, fruit-growers, especially, have been keeping close watch over their orchards to guard against the introduction of this—one of our most dangerous fruit tree pests.

There are half a dozen or more scale insects found on our fruit trees. These vary in size and color according to the genus and subfamily to which they belong; but they nearly all agree in that they are covered over with a sort of an armor or protecting, shield-like envelope. This covering is what gives them their popular name—"scale insects." The scale, shield, or covering, is a secretion from the insect itself, which lies beneath it, usually stationary, and fixed to the bark of the tree, which it penetrates with a long, slender beak. With this beak it sucks out the juices of the bark, and when present in great numbers they weaken the tree to such an extent that it either does not bear any fruit or, in the case of the San Jose' scale, kills it.

HOW TO DETECT THE SAN JOSE' SCALE.

To find out whether a tree has this scale, examine the bark of the twigs, branches and trunk of the tree carefully, and if it is covered with an unhealthy looking crust, which comes off in thin scales when scraped with a knife blade, or with the finger nail, the chances are that it has this scale or some scale insect closely related to it. When the bark is rubbed hard with the finger, the minute insects are crushed, giving to the bark a sort of greasy appearance. Very often, on the young branches, especially, the affected bark becomes reddened and blotched. Where the bark has been infested with the San Jose' for a year or two the scales become so numerous that they form several layers deep, giving to the bark a dark, grayish, unnatural color. The individual scales are too small to detect without a pocket lens. When seen under a lens, the female scales are found to be round and slightly raised or conical in outline. The center of the scale is raised by a nipple like projection, which is surrounded by a distinct ring. The male scales are smaller, and have the nipple projection near the anterior end. The females become permanently fixed to the bark soon after they are born, and remain in the same

spot until they die; and even after death the scale part still remains. The males also lie fixed to the bark, but get wings at maturity, and are then easily recognized with a lens.

The above brief description will give one an idea of how to detect it; but the San Jose' scale has a few very closely related species which are not easily distinguished from it. There are none, however, that are so destructive, and should be so closely watched for, as the San Jose'.

THE SAN JOSE' SCALE IN SOUTH CAROLINA.

The San Jose' scale has been found in this State quite widely distributed, and, where it has gained a foothold, has proven very destructive. There are very few nurseries in South Carolina, and these have been found free from it, as far as we know. It must, therefore, have been introduced through nursery stock purchased from other States.

It is a well known fact that the San Jose' scale has been disseminated over large areas of the country through the stock sold by nurseries infested with it. The natural spread of the scale is rather slow. Birds may carry it from tree to tree in the same orchard, but the chances are that they will not carry it for any great distances. Fruit growers and nurseries that are now free from it can practically keep it out by refusing to buy any stock from any nursery or dealers without a certificate that such stock has been fumigated with hydrocyanic gas and is accompanied by a certificate stating that it is free from dangerous pests.

Where it has already been introduced, the question arises, can it be completely exterminated? With thorough and repeated treatment it probably can, but even if it cannot be completely eradicated it can be checked and controlled without much expense, and as easily as many other insects that the fruit and truck-growers have to combat. The Irish potato beetle, when left alone, will soon eat up every green potato leaf in the field. But with as simple a remedy as Paris-green there is no necessity for allowing this to occur. Still the potato beetle has been poisoned, killed and picked for over twenty-five years in the United States, but it is still with us, and is here to stay. The same will probably be found true with the San Jose' scale. It will be hard to exterminate completely without at the same time injuring the trees; but with persistent effort it can be controlled.

TREATMENT FOR THE SAN JOSE' SCALE.

There are several remedies which have been found effective against the scale, but the kerosene treatment is undoubtedly the best and cheapest. Pure kerosene can not be used on account of its injurious effects on the foliage in summer, and even in winter, when the branches are without leaves, it is safest not to apply it pure, as it will injure the bark, except when applied in a very fine spray or mist on clear days. This is especially the case with peach trees.

For our State the mechanical mixture of kerosene and water is probably the best. For spraying the kerosene and water mixture, however, it is necessary to have special spray pumps, which mix the oil and water mechanically when it is being applied. These pumps are usually known as "kero-water" sprayers, and can be had either in barrel or knapsack form. When much spraying is to be done, it is best to get a barrel pump. The kero-water sprayers are so constructed that the percentage of kerosene desired can be regulated, simply by turning an index. These pumps can also be had with attachments for spraying with Bordeaux mixture, etc., thus doing away with the necessity of getting a separate pump for fungi.

SUGGESTIONS FOR SUMMER TREATMENT.

The best time to treat trees for the San Jose' is in the winter, when there is no foliage on the trees; but it is necessary to spray in the summer also when the scales are multiplying rapidly, and it is dangerous to let them go unchecked until the time for the winter treatment. Whenever trees are found in the summer with living scales, spray them with a 10 per cent. strength of kerosene in water. Trees that are so badly crusted over with the scales that they are already beginning to die should be burned. Very badly infested branches and twigs of otherwise vigorous trees should be cut off and burned. Preliminary to spraying, the trees should be pruned back. This results in an economy of spray and makes more thorough work possible.

A good plan to follow would be to go through the orchard and examine every tree, marking with a paint or whitewash brush those with scales. With a pocket lens or magnifying glass the infested trees are readily distinguished from the healthy ones. The marked trees to be burned should be carefully removed a few inches below the soil and burned on the spot. The others should be sprayed with 10 per cent. kerosene in water, and carefully watched during the

summer. Some of the trees might be used for experimenting upon with different strengths of oil in water. A 15 per cent. oil mixture is very often advised and, when carefully applied, can be used.

Spraying should be done on a bright, dry day, so that the oil will evaporate as quickly as possible. The oil evaporates more slowly on a moist, cloudy day, and the tree is more apt to be injured by some of the oil penetrating the bark. A thorough application is necessary; but the oil and water should never be put on so much that it runs down the trunk and collects about the base. It must be remembered, however, that every scale insect that is to be killed must be actually touched with the oil; and, therefore, every twig, branch and the trunk of the tree must be moistened; and this is best done with a mist-like spray. Care should be taken that the scales are not carried on pruning and other tools from infested to healthy trees. Spray the infested trees several times during the summer, if necessary.

SUGGESTIONS FOR WINTER TREATMENT.

The suggestions given above for summer treatment are also applicable to the winter treatment. The same care in spraying, cutting out and pruning should be exercised, but the strength of oil may be increased to 20 per cent. (A 25 per cent. strength is often advised). The orchard should be gone through more carefully, and should be sprayed twice, at least—once in the fall, as soon as the foliage has dropped, and once in the spring, before the buds begin to open. It will be found, very likely, that the scale has spread some during the summer, and that new trees need to be marked and treated. We do not believe in spraying the whole orchard, but only those trees that are found with scales.

It is somewhat difficult to distinguish the San Jose′ scale from its closely related species, but some of these are also injurious, and should be treated. The same treatment is effective against all scale insects.

OTHER SUGGESTIONS AND INFORMATION.

Kerosene should be bought by the barrel, and of a good grade—not necessarily the best, but one not lower than 120° flash test. The oil ought not to cost more than 10 cents a gallon in barrel lots. Forty gallons of kerosene will spray from 200 to 500 trees, depending upon their size.

This does not make the treatment expensive, especially when a scrupulous watch is kept over the orchard, so that it becomes necessary to spray only a part of it.

Secure from the United States Department of Agriculture, and from the Agricultural Experiment Stations, bulletins and circulars dealing with the San Jose′ scale and other scale insects, as well as plant diseases. These bulletins and circulars can be had for the asking, but have often saved the planter and fruit-grower thousands of dollars.

Whenever in doubt as to whether it is the San Jose′ scale, send a piece of a twig, branch, or cutting of bark, to the Entomologist, who will report the results of an examination of such specimen.

In this first circular the San Jose′ scale only has been taken up. Other scale insects and crop and orchard pests will be treated of in circulars to be published later.

The following are the addresses of a few spray pump manufacturers:

Gould Manufacturing Co., Seneca Falls, N. Y.; The Deming Co., Salem, Ohio; W. & B. Douglas, Middleton, Conn.; Field Force Co., Lockport, N. Y.

AN ACT

To Create a State Board of Entomology, to Define its Powers, and Prescribe its Duties, and Provide for the Inspection of Fruit Trees, Vineyards, and Vegetable Farms, to Prevent Contagious Diseases, and Destroy Destructive Insects in Orchards, Vineyards and Other Places in this State.

SECTION 1. Be it enacted by the General Assembly of the State of South Carolina: That on or before April 1st, 1901, and every two years thereafter, the Board of Trustees of Clemson College shall designate three members of the said Board, who shall constitute and be known as the State Board of Entomology, and who shall be charged especially with the execution of the provisions of this Act.

SEC. 2. That the said Board shall have full power to adopt such rules and regulations governing the inspection, certification, sale, transportation and introduction of trees, plants, shrubs, cuttings, buds, vines, bulbs, or roots, that they may deem necessary or advisable to prevent the introduction or dissemination of destructive pests and plant diseases in this State.

Sec. 3. That the said Board shall have power to appoint an Entomologist, who shall be a skilled horticulturist; and an Assistant Entomologist if, in their judgment, it shall be impracticable for the Entomologist so to be appointed to discharge the duties hereby devolved upon him; and such Entomologist shall act as an inspector under the provisions of this Act; and it shall be the duty of said Board to promulgate rules and regulations in accordance with this Act for the guidance of said Entomologist and his assistant, if one shall be appointed, in the duties devolving upon him under the provisions hereof.

Sec. 4. That the said Board shall fix the salary of said Entomologist, and of his assistant, if one shall be appointed; the said salary shall be paid out of the funds now provided by law for the uses of Clemson College; and in addition to said salaries, such expenses as the said Board may allow for traveling and other incidental expenses of the Entomologist and his assistant, and the issuing of reports, or other publications, shall be paid out of the funds provided for the uses of Clemson College.

Sec. 5. The Entomologist shall have power under the regulations of the said Board to visit any section of the State where insects injurious to or destructive of plants are believed to exist, and shall determine whether any infested trees or plants or vineyards are worthy of remedial treatment, or should be destroyed; and he shall report his findings in writing to the owner of the premises where such trees or plants or vineyards are situated, or to his agent or tenant, and a copy of his report shall also be submitted to the said Board. In case of objection to the finding or report of the inspector, an appeal may be had to the said Board, who shall have the power to summon witnesses and hear testimony on oath, and whose decision shall be final. Upon the finding of the inspector in any case of infested trees or plants or vineyards, the treatment prescribed by him shall be executed by the owner of the premises unless an appeal is taken, and the cost of material incident to such treatment shall be borne by the owners of the premises: *Provided, however,* That in case the trees or plants or vineyards shall be condemned by the inspector, they shall be destroyed, by his direction, by the owner of the premises, and the expense of said action shall be borne by the owner of the premises: *Provided,* That failure or refusal on the part of the owner of the premises to execute the treatment prescribed by the Entomologist, or to destroy trees, plants or vineyards as directed by him, shall be deemed a misdemeanor, and, upon conviction

thereof, such owner shall be punished by a fine not exceeding one hundred dollars, or imprisonment in the county jail not exceeding thirty days: *And provided, further,* That the provision in reference to destroying plants shall not refer to cotton, corn, grain or such other field plants as are not subject to sale and transportation. No compensation shall be paid to the owner of the premises for any plant that shall thus be destroyed.

Sec. 6. It shall be unlawful to sell, or offer for sale, or transport plants, buds, trees, shrubs, vines, tubers, bulbs, roots or cuttings known to be infested with dangerous or injurious insects or plant diseases; and any person or persons violating the provisions of this Section shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined in a sum not exceeding one hundred dollars, or imprisonment in the county jail not exceeding thirty days.

Sec. 7. That the said Entomologist, or his assistant, is hereby authorized and empowered to enter upon any premises in this State for the discharge of the duties hereby prescribed, or that may be prescribed by said Board; and any person or persons who shall pester or hinder him in the discharge of such duties shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by a fine not exceeding one hundred dollars, or by imprisonment in the county jail not exceeding thirty days.

Sec. 8. The said Board shall have the power to adopt rules and regulations, consistent with the laws of this State, and of the United States, for preventing the introduction of injurious crop pests from without the State, and for the government of common carriers in transporting plants liable to harbor such pests to and from the State.

Sec. 9. It shall be unlawful for any grower of fruit trees, nurserymen, or corporation to ship within this State any trees, shrubs, cuttings, vines, bulbs, or roots without having the same previously examined by said Entomologist, or by his assistant, within six months next preceding date of such shipment—a certificate of such inspection in such form as may be adopted by said Board to accompany each box or package. Any person or corporation violating the provisions of this Section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding one hundred dollars, or be imprisoned in the county jail not exceeding thirty days.

Sec. 10. That all fruit growers, nursery-men or corporations residing in this State dealing in or handling fruit trees, shrubs, cuttings, vines, bulbs, or roots, shall be compelled to have his or their

stock inspected annually on or before the 1st day of November of each year. If upon such inspection such stock is found to conform to the requirements of said Board, the inspector shall furnish a certificate to that effect; or if such stock shall not conform to the requirements of said Board, then the said inspector may cause the same to be destroyed, at the expense of the owner thereof: *Provided,* That any fruit grower, nursery-man or corporation residing without this State, and desiring to sell trees, shrubs, cuttings, vines, bulbs, or roots within this State, may notify the State Entomologist of this State, who shall inspect and certify their stock: *Provided,* Such fruit grower, nursery-man or corporation shall pay all costs incident to such inspection and certification.

Sec. 11. That all persons or corporations residing without the limits of this State, dealing in trees, plants, cuttings, shrubs, vines, or roots, shall register his, their or its name, and file a copy of his, their or its certificate of inspection furnished by the Entomologist, or Inspector, or duly authorized official of the State in which he or they or it resides, with the Chairman of said Board. Upon failure to comply with this requirement, any of said articles that may be shipped into this State may be confiscated or destroyed by the authority of said Board.

Sec. 12. When two or more reputable citizens of any County in this State notify the Chairman of the State Board of Entomology that noxious insects or plant diseases exist in their County, it shall be his duty to have the Entomologist promptly investigate the matter, and take such steps as authorized and prescribed in this Act and by the State Board of Entomology.

Sec. 13. The said Board is hereby authorized and empowered to make such rules and establish such regulations to carry out the provisions of this Act as in their judgment will best promote the accomplishment of the purposes intended to be effected by this Act.

Sec. 14. This Act shall take effect from and after its passage.

Approved the 19th day of February, A. D. 1901.

M. B. McSWEENEY, Governor.

In the Senate House the fifteenth day of February in the Year of Our Lord One Thousand Nine Hundred and One.

JAS. H. TILLMAN, President of the Senate.

W. F. STEVENSON,

Speaker of the House of Representatives.

A True Copy—Attest:

M. R. COOPER, Secretary of State.

RULES AND REGULATIONS ADOPTED BY THE BOARD

In accordance with an Act of the Legislature of South Carolina approved the 19th of February, A. D. 1901, we, the Board of Entomology, appointed according to the provisions of said Act, by the Board of Trustees of Clemson College, have adopted the following rules and regulations to govern the inspection, certification, sale, transportation and introduction of trees, plants, shrubs, cuttings, buds, vines, bulbs, or roots, that they may deem necessary or advisable to prevent the introduction or dissemination of destructive pests and plant diseases in the State:

1. The Entomologist at Clemson College shall direct the work required under this Act.

2. The following insects and plant diseases are declared by the State Board of Entomology to be dangerously injurious, and the introduction of the same is hereby forbidden, and to be prevented, as far as possible, in accordance with the law: (a) The San Jose' Scale, (b) The Oyster Shell Scale, (c) The Peach Yellows, (d) The Plum and Peach Rosette, (e) Black Knot of Plum and Cherry.

3. The Entomologist shall inspect every nursery in the State durings the months of August and September of each year. Infested orchards shall be treated whenever discovered. The owner of infected orchards or nurseries shall pay all cost for such treatment except the traveling and hotel expenses of the Entomologist.

All nurserymen and dealers of nursery stock located and doing business within the limits of the State of South Carolina must not sell, transport, or give away any nursery stock unless the same is accompanied by a certificate from the Board of Entomology declaring the same to be apparently free from the above named dangerously injurious insects and plant diseases. All such certificates are invalid after the first day of June each year, and must be renewed before the first day of October of that year.

4. The Entomologist shall furnish certificates to all growers of fruit trees, or nursery-men, residing without the State, who may apply to him for the same, in order that they may have inspection made by competent authority to ship their products to customers within this State.

5. It shall be the duty of the Entomologist to furnish a copy of the laws of this State, "to prevent contagious diseases, and destroy destructive insects in orchards, vineyards and other places in this State," to all public carriers or transportation companies, and to exercise all due diligence to see that the law is complied with.

6. The Entomologist shall without delay report all cases of violation of law under this Act to the Chairman of the Board of Entomology, coming within his knowledge.

7. The Entomologist shall keep on file, and for ready reference, a list of nurseries, and dealers of nursery stock, permanently located and doing business within the State of South Carolina.

8. A similar list to the above shall also be kept, which is to include, as far as possible, all nurseries, and dealers of nursery stock, without the State, who are shipping into, delivering, or selling, either direct or through their agents or solicitors, any of their stock in this State.

9. A list of localities, nurseries, and orchards in the State where the San Jose' Scale, or other dangerously injurious insects or plant diseases are found shall be kept on file, for ready reference, in his office.

The Entomologist shall keep on hand, for one year, all specimens and parts of plants sent to him from different parts of the State and found to be affected with insect pests and other dangerous plant diseases.

11. All correspondence relating to his duties and work as Entomologist to the Board shall be kept in separate letter files and copying books.

12. The Entomologist shall publish, from time to time, circulars and reports relating to the inspection work, and any matter pertaining to the distribution, life, histories and methods of treatment of insect pests and other diseases of plants, or other matters that may aid in the suppression of insect pests and plant diseases.

M. L. DONALDSON,
J. E. WANNAMAKER,
L. A. SEASE,
Board of Entomology.

BULLETIN 66. FEBRUARY, 1902.

South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

Feeding Corn Stover.

Dehorning Milch Cows.

Address all communications to

S. C. EXPERIMENT STATION, Clemson College, S. C.

Freight and Express Office: Calhoun, S. C.

Telegraph Office: Clemson College.

The Bulletins of this Station are sent FREE to all citizens of the State requesting them.

Bulletins are not issued monthly, but at irregular intervals, not less than four a year.

OFFICERS OF EXPERIMENT STATION.

Henry S. Hartzog, LL. D., President of College	Director
J. S. Newman	Vice Director and Agriculturist
M. B. Hardin	Chief Chemist
F. S. Shiver, Ph. G.	Assistant Chemist
C. C. Newman,	Horticulturist
R. N. Brackett, Ph. D.	Assistant Chemist
G. E. Nesom, B. Sc., D. V. M.	Veterinarian
*C. C. McDonnell, B. S.	Assistant Chemist
C. M. Conner, B. S.	Assistant Agriculturist
C. E. Chambliss	Entomologist
*B. F. Robertson, B. S.	Assistant Chemist
C. O. Upton	Dairyman
D. H. Henry	Assistant Chemist
J. S. Pickett	Foreman
John N. Hook	Secretary and Librarian

*Engaged in Fertilizer Analyses.

Feeding Corn Stover.

C. M. Conner, Assistant Agriculturist.

In view of the fact that a large amount of corn stover* has been saved this fall, and as numerous calls are coming in for information in regard to its feeding value, it is thought best to publish the results of an experiment along this line. While the work has not been extensive, it will give those who have corn stover on hand some idea of its feeding value. There are thousands of dollars worth of feed wasted in this State every year, by the expensive method of pulling fodder. It is true that there is some danger of losing some of the corn and stover during rainy weather and those who had such good success this fall should bear this in mind hereafter. If the shocks have been properly put up and they have had time to settle well before the rainy season sets in, there is not much danger of losing any corn. Binder twine is very good for tying the top of the shocks, after they have been pulled together with a plow line.

As to cost of cutting corn by hand, we found that six hands could cut and shock a given area in the same time that they could pull the fodder and tie it in hands. Where a machine is used for cutting the corn the cost per acre is much less.

In order to determine the yield per acre of corn stover, or blades as the case may be, three sets of plats were laid out; one set on bottom land and two sets on upland. The yields were combined and given in the following table. The object here being to show the relative amount of stover or blades, per bushel of corn. The corn was a large white variety used on the farm.

*"Corn stover" means the whole stalk after the ear has been taken off, while "fodder" means the blades saved by the usual method in the South.

Plot Number.	Yield of grain. Bus. per acre.	Yield of stover. Lbs. per acre.	Yield of blades. Lbs. per acre.
1: Corn cut 6 inches above the ground....	25. 7	1,647	....
2. Fodder pulled in usual way...........	26.3	....	389
3. Tops cut, only.......................	23.4	695	....
4. Fodder pulled above the ear..........	21.7	....	157
5. Fodder pulled below the ear..........	23.3	....	255

From the above table we learn that a little over four times as much roughness per acre may be obtained by saving the whole stalk than where the blades only are saved.

Armsby gives the following as the composition of the corn and stover from an acre-average of crop at four stations:

Digestible nutrients.	Ear. Lbs.	Stover. Lbs.	Total crop. Lbs.
Protein	244	83	327
Carbohydrates	2,301	1,473	3,774
Ether extract	125	22	147
Total..................	2,670	1,578	4,248
Per cent..................	63	37	100

We learn from the above table that 37 per cent. of the total digestible nutrients in a crop of corn grown for grain is found in the stover and 63 per cent. in the ears. Most Southern grown corn will show about 40 per cent. in the stover and 60 per cent. in the ears.

The practical feeders have found that good shredded corn stover is equal to timothy hay for wintering cattle.

The following experiment was conducted to find the feeding value of shredded corn stover as compared with cotton seed hulls, hulls being used largely throughout the State for feeding with cotton seed meal.

Eight average cows were selected from the herd for this experiment. They were weighed and divided into two lots as nearly equal as possible, so far as the milk flow and breed were concerned.

The following table shows the breed, age, weight, number of days since calving, milk flow and average per cent. of butter fat:

	Breed.	Age in years.	Weight.	Days since calving.	Average lbs. of milk per day.	Av. per cent. of butter fat.
Lot. I.						
Alphea's Juliet.	Jersey.	5	715	76	20.3	4.6
Lilly.	Holstein grade.	6	870	120	17.7	3.6
Myrtle.	Holstein grade.	6	950	118	26.4	4.1
Greenville . . .	Holstein grade.	8	890	180	20.4	5.7
Average. . .	. . . .	6.2	856	123	21.2	4.5
Lot II.						
Kate	Jersey grade. . .	4	720	73	24.3	5.1
Bessie	Holstein grade.	3	955	103	19.5	3.0
Lula	Holstein grade.	4	842	91	17.9	4.0
Black.	Holstein grade.	3	795	55	22.9	4.7
Average . . .	. . . .	3.5	828	80	21.1	4.2

The cows were fed ten days as a preliminary period and then fed for thirty-one days as follows: Lot I. Four pounds of cotton seed meal, eight pounds of wheat bran, and all the cotton seed hulls they would clean up per day. Lot II. Four pounds of cotton seed meal, eight pounds of wheat bran and all the shredded corn stover they would eat without waste, per day. In case they were given more hulls or stover than they would eat it was weighed back. They consumed all the meal and bran given them.

The following table gives the amount of feed consumed and milk produced by each cow per day:

Lot I.

Cow.	Alphea's Juliet.			Lilly.			Myrtle.			Greenville.		
	Food Consumed.			Food Consumed.			Food Consumed.			Food Consumed.		
Date. Days.	Grain. Lbs.	Hulls. Lbs.	Milk pro-duced. Lbs.	Grain. Lbs.	Hulls. Lbs.	Milk pro-duced. Lbs.	Grain. Lbs.	Hulls. Lbs.	Milk pro-duced. Lbs.	Grain. Lbs.	Hulls. Lbs.	duced. Lbs. Milk pro-
Dec. 1........	12	18.0	17.3	12	22.0	17.4	12	30.0	21.8	12	30.0	20.0
Dec. 2........	12	18.0	17.7	12	22.0	17.9	12	30.0	22.4	12	30.0	17.5
Dec. 3........	12	18.0	16.2	12	21.9	17.9	12	29.0	23.5	12	28.8	21.1
Dec. 4........	12	16.6	15.5	12	22.0	14.9	12	30.0	22.1	12	28.1	18.5
Dec. 5........	12	10.2	16.2	12	16.6	17.8	12	22.5	22.2	12	24.6	17.9
Dec. 6........	12	12.2	17.7	12	12.6	17.0	12	22.3	24.5	12	20.1	20.7
Dec. 7........	12	16.0	17.0	12	20.0	17.5	12	23.0	18.2	12	16.2	18.2
Dec. 8........	12	16.0	18.2	12	20.0	17.2	12	13.1	19.3	12	24.0	15.1
Dec. 9........	12	16.0	19.2	12	20.0	17.3	12	18.0	20.3	12	24.0	16.2
Dec. 10........	12	16.0	16.9	12	22.0	17.6	12	22.0	21.1	12	25.0	16.1
Dec. 11........	12	16.0	17.9	12	22.0	17.7	12	22.0	19.9	12	25.0	17.7
Dec. 12........	12	18.0	17.4	12	24.0	18.2	12	26.0	20.4	12	28.0	16.6
Dec. 13........	12	15.9	17.3	12	24.0	18.1	12	26.0	21.5	12	28.0	19.9
Dec. 14........	12	13.8	18.5	12	24.0	18.9	12	26.0	23.4	12	27.7	20.1
Dec. 15........	12	14.6	16.4	12	23.0	19.3	12	26.0	24.2	12	27.7	20.1
Dec. 16........	12	4.8	16.3	12	18.2	17.8	12	25.9	22.4	12	26.0	20.3
Dec. 17........	12	8.7	15.8	12	16.7	19.0	12	28.0	23.2	12	27.0	20.6
Dec. 18........	12	16.6	15.8	12	18.9	18.5	12	27.8	22.8	12	27.7	20.7
Dec. 19........	12	14.9	17.2	12	21.4	19.4	12	30.0	23.7	12	27.9	21.6
Dec. 20........	12	12.4	15.6	12	19.0	19.0	12	28.3	24.4	12	27.8	22.2
Dec. 21........	12	15.0	14.7	12	21.9	19.0	12	30.0	24.1	12	30.0	22.1
Dec. 22........	12	14.7	16.2	12	19.9	19.2	12	30.0	24.4	12	30.0	21.6
Dec. 23........	12	9.1	17.5	12	19.9	20.4	12	30.0	24.3	12	30.0	21.7
Dec. 24........	12	11.6	16.3	12	18.1	19.6	12	27.2	23.5	12	27.3	22.2
Dec. 25........	12	10.6	15.4	12	19.8	19.2	12	30.0	25.1	12	29.9	20.3
Dec. 26........	12	12.1	15.3	12	20.0	19.4	12	29.9	25.7	12	28.6	19.8
Dec. 27........	12	13.0	15.1	12	17.1	19.0	12	32.0	23.7	12	27.7	20.5
Dec. 28........	12	13.9	15.7	12	21.9	19.8	12	32.0	23.9	12	30.0	20.0
Dec. 29........	12	11.5	16.2	12	20.5	19.4	12	32.0	25.0	12	29.3	20.3
Dec. 30........	12	15.1	16.9	12	20.4	19.2	12	33.9	24.4	12	34.3	20.6
Dec. 31........	12	13.9	15.5	12	12.6	17.5	12	20.5	23.3	12	28.2	21.0
Total........	372	433.2	514.9	372	622.4	572.1	372	833.4	708.7	372	848.9	609.2

Lot II.

Cow.	Kate.			Bessie.			Lula.			Black.		
	Food Consumed.		Milk produced. Lbs.	Food Consumed.		Milk produced. Lbs.	Food Consumed.		Milk produced. Lbs.	Food Consumed.		Milk produced. Lbs.
Date. Days.	Grain. Lbs.	Stover. Lbs.		Grain. Lbs.	Stover. Lbs.		Grain. Lbs.	Stover. Lbs.		Grain. Lbs.	Stover. Lbs.	
Dec. 1........	12	14.0	17.4	12	18.0	17.5	12	18.0	15.0	12	14.0	17.9
Dec. 2........	12	14.0	18.7	12	18.0	17.2	12	18.0	15.1	12	14.0	17.8
Dec. 3........	12	1.8	18.3	12	6.8	17.8	12	14.7	15.8	12	7.9	18.4
Dec. 4........	12	12.0	16.3	12	16.0	15.6	12	18.0	13.0	12	13.0	16.1
Dec. 5........	12	6.1	17.2	12	10.0	17.2	12	11.0	13.6	12	8.2	16.2
Dec. 6........	12	3.3	18.5	12	7.0	18.5	12	11.0	14.7	12	8.2	17.5
Dec. 7........	12	6.8	19.0	12	5.4	17.3	12	7.4	15.7	12	8.6	17.2
Dec. 8........	12	8.5	18.9	12	9.2	15.2	12	12.1	15.7	12	6.8	17.5
Dec. 9........	12	12.0	19.0	12	14.0	14.6	12	16.0	16.2	12	12.0	18.1
Dec. 10........	12	7.4	19.4	12	14.0	15.2	12	11.3	16.2	12	5.9	18.0
Dec. 11........	12	10.2	18.8	12	11.5	16.1	12	14.1	16.3	12	9.9	18.9
Dec. 12........	12	9.4	18.4	12	10.0	15.4	12	12.5	16.5	12	7.2	18.3
Dec. 13........	12	8.4	19.9	12	12.2	15.9	12	15.0	16.7	12	11.0	19.0
Dec. 14........	12	10.9	19.4	12	12.6	16.2	12	14.4	16.9	12	10.4	18.4
Dec. 15........	12	10.6	17.4	12	12.4	15.7	12	14.8	17.4	12	11.4	18.4
Dec. 16........	12	9.4	16.6	12	10.9	14.5	12	9.2	16.8	12	11.5	18.7
Dec. 17........	12	6.2	18.8	12	12.4	15.5	12	14.1	15.7	12	12.8	19.2
Dec. 18........	12	9.8	19.7	12	12.4	15.7	12	13.8	19.2	12	13.1	19.6
Dec. 19........	12	9.7	20.3	12	12.1	18.4	12	14.3	18.1	12	11.8	19.9
Dec. 20........	12	10.1	20.0	12	11.7	16.0	12	14.8	17.1	12	14.0	19.6
Dec. 21........	12	10.1	20.6	12	13.7	16.2	12	15.4	17.8	12	13.0	20.2
Dec. 22........	12	9.8	17.6	12	11.8	16.0	12	15.4	16.4	12	15.0	19.8
Dec. 23........	12	9.8	20.3	12	11.8	16.6	12	15.8	17.6	12	14.7	19.9
Dec. 24........	12	9.2	19.9	12	12.0	16.8	12	14.9	18.0	12	12.9	20.3
Dec. 25........	12	10.1	19.4	12	13.6	15.6	12	17.8	18.5	12	15.1	20.2
Dec. 26........	12	11.5	19.7	12	11.8	15.3	12	17.6	19.0	12	13.8	19.5
Dec. 27........	12	9.3	19.1	12	13.2	16.1	12	17.6	18.6	12	14.7	17.8
Dec. 28........	12	11.5	20.4	12	12.9	16.0	12	16.1	18.6	12	11.9	20.4
Dec. 29........	12	8.5	20.1	12	13.7	16.6	12	15.8	18.8	12	12.9	19.0
Dec. 30........	12	12.5	20.1	12	17.1	16.4	12	20.8	17.2	12	16.6	18.7
Dec. 31........	12	5.6	19.6	12	10.9	15.5	12	9.0	18.6	12	10.5	19.6
Total........	372	288.7	588.8	372	379.1	502.6	372	450.7	520.8	372	362.8	580.1

Combining the totals of the above table we have the following table, showing the amount of feed consumed, cost of feed, milk produced and cost of producing a gallon of milk:

	Meal and bran. Lbs.	Cottonseed hulls. Lbs.	Corn stover. Lbs.	Total cost of feed for 31 days.	Number gallons of milk produced.	Average cost per gal. milk, cts.
Lot I.						
Alphea's Juliet	372	433.2	. . . . . .	$4 47	59.9	7.46
Lilly.	372	622.4	. . . . . .	4 84	66.5	7.28
Myrtle.	372	833.4	. . . . . .	5 27	82.4	6.38
Greenville.	372	848.9	. . . . . .	5 30	70.8	7.46
Total.	1,488	2,737.9	. . . . . .	$19 88	279.6	28.58
Average	372	684.5	. . . . . .	4 97	69.9	7.14
Lot II.						
Kate.	372	. . . . . .	288.7	4 17	67.3	6.05
Bessie.	372	. . . . . .	379.1	4 36	58.4	7.47
Lula	372	. . . . . .	450.7	4 50	60.6	7.42
Black.	372	. . . . . .	362.8	4 33	67.5	6.41
Total.	1,488	. . . . . .	1,481.3	$17 36	253.8	27.35
Average	372	. . . . . .	370.3	$4 34	63.4	6.84

As there is no established market price for the corn stover, it was rated at the same price as cotton seed hulls; namely, $4.00 per ton. The price of the bran was $20.00 per ton and the cotton seed meal $18.00 per ton. These prices were used in calculating the cost of the rations.

Definite conclusions cannot be drawn from this experiment, on account of the limited time during which it was carried on, but it shows that the corn stover has a greater feeding value, than cotton seed hulls. With the same amount of grain feed, lot II. produced milk at a cost of 6.84 cents per gallon, while lot I., fed on hulls, produced milk at 7.14 cents per gallon.

Attention is called to the relative amounts of hulls and stover consumed by each lot.

Dehorning Milch Cows in Full Flow of Milk.

It has been claimed that dehorning cows while in full flow of milk did not check the milk flow. During February, 1900, we dehorned a number of cows, and in order to note the effect of dehorning, we kept a careful record of the milk flow. The following table shows the milk flow for five days preceding and five days succeeding the dehorning.

Name of Cow.	Five Days Preceding Dehorning.						Five Days Succeeding Dehorning.						
	Feb. 14.	Feb. 15.	Feb. 16.	Feb. 17.	Feb. 18.	Total for 5 Days.	Feb. 19.	Feb. 20.	Feb. 21.	Feb. 22.	Feb. 23.	Total for 5 Days.	Per Cent. Gain (+) or Loss (—)
Spot . . .	15.6	16.6	16.8	15.3	14.1	78.4	14.3	15.5	13.3	16.0	14.5	73.6	—06.1
Luceil . .	24.3	25.4	24.4	26.5	24.6	125.2	13.2	13.1	18.2	18.7	16.8	80.0	—20.0
Duchess. .	25.8	24.4	24.7	25.1	23.9	123.9	22.1	24.0	23.0	23.0	24.0	116.1	—6.2
Filpail . .	11.4	14.1	14.9	12.8	13.1	66.3	12.6	14.3	14.4	13.8	13.8	68.9	+4.1
Alice . . .	15.6	15.5	15.5	14.8	14.9	76.3	11.5	11.8	13.2	13.3	12.6	62.4	—18.2
Bloss . . .	8.5	9.3	8.7	9.0	9.2	44.7	8.5	6.9	7.8	7.7	8.0	38.9	—12.7
Sibyl . . .	19.9	20.8	17.7	19.7	18.2	96.3	16.9	17.6	18.5	19.3	20.3	92.6	—3.8
Total . .	121.1	126.1	122.7	123.2	118.0	611.1	99.1	103.2	108.4	111.8	110.0	532.5	

All the cows in the above list were over three years old. Luceil was nine years old and had very large horns.

The dehorning was done with a pair of dehorning clippers which fractured the bone to some extent and possibly caused the animals to suffer more than they would, if a saw had been used on the large horns.

Luceil dropped 46 per cent. in milk flow the first day and 20 per cent for the five days; Alice dropped 18.2 per cent. and Bloss 12.7 per cent. during the five days, while Duchess, Spot and Sibyl did not seem to be much affected.

The total loss of the seven head amounted to 16.1 per cent. during the five days.

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South Carolina Agricultural Experiment Station.

Clemson Agricultural College.

(S. C. A. & M. COLLEGE.)

Stock Feeding.

Address all communications to

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STOCK FEEDING.

C. M. CONNER, Assistant Agriculturist.

The Southern farmers have given a great deal of thought to plant feeding, in order that they may grow the largest and best crops possible, provided the cost of production does not prevent making a profit.

Very little attention has been given to stock feeding, the work stock being fed largely on purchased food, the hay being shipped in when it could be raised on the farm at much less cost.

The number of prime beef cattle grown in this and adjoining States is very small and the limited quantity is due largely to the lack of knowledge of the feeding value of many of our common feeding stuffs. Not only a knowledge of the feeding value of the individual plants, but how to combine them to get best results for least cost. Hence it is thought best to preface this bulletin with some of the principles of stock feeding which may be applied to feeding the fattening steer, work animal, or the dairy cow.*

When you feed an animal you should expect to get some return for the food given. This return may be in the form of work, flesh formed or milk produced. The food taken in by the animal is used first to supply the wants of the body of the animal, secondly to do work. As we would say about a steam engine, the first fuel is used to run the machinery of the engine itself, then if work is to be done, more must be supplied.

If a *small* amount of food is given it is possibly all used to run the machinery of the body, in that case the animal is not capable of doing any work without drawing upon its reserve supply and, if this course is persisted in, the reserve supply will give out and the animal will not be able to do any work at all. This is the reason the work animal will lose flesh if it is required to do work beyond its capacity.

Now, feeding animals is very much like feeding plants; the fertilizers you use are made up of nitrogen, phosphoric acid and potash, the other elements are already in the soil and you give very little attention to them. In stock feeding the food consists of protein, carbohydrates and fat. The other elements required by the animal are supplied in abundance, when enough of the ordinary foods are given to supply the required amount of protein, carbohydrates and

bulletinitten as a supplement to bulletin No. 66.

fat. Every farmer who is familiar with the use of fertilizers knows that he cannot grow cotton with nitrogen alone, or with potash alone; he knows that there must be a combination of these present in the soil to get the best results. This combination is the thing to be worked out, both for feeding animals and plants. If we use too much nitrogen on our plants, we lose all over and above that taken up by the plant. Just so in feeding animals, we must have a combination of protein (nitrogen), carbohydrates and fats in order to get the best results. This combination will depend upon what the animal is required to do.

Now, a few words as to what we mean by protein, carbohydrates and fat. So far as the feeder is concerned, the plant is made up of

Water,
Ash,
Protein,
Carbohydrates,
Fat

All our feeding stuffs contain more or less water, the hay, cotton seed meal, cotton seed hulls and numerous other foods which seem dry, contain some water. When we estimate the yield of any crop grown per acre, the only rational way is to estimate the amount of absolutely dry matter. The table of analysis given in this bulletin has a column showing the amount of dry matter in 100 pounds.

The ash is what is left of the feeding stuff, after it has been burned. That which makes the ash furnishes the mineral matter for the animal. There is usually no need of taking into consideration the amount of ash in a feeding stuff, unless you are feeding very young animals, for example if you feed young hogs on corn exclusively they will develop a weak frame.

Protein is that part of the food which is used to build up the tissue of the body. This tissue may be new tissue or worn out tissue. The white of an egg is perhaps the best example of protein. Protein is necessary to the production of flesh, milk, hair, wool, blood, horn and many other parts of the body where nitrogen is found. When work is done tissue is broken down and, in order to repair it, protein must be supplied. When a cow is giving a heavy flow of milk, she uses up a great deal of protein in making this milk, hence she must receive a liberal supply in her food.

Starch and sugar are good examples of carbohydrates. Carbohydrates make up the bulk of the leaves and stems of our forage plants, and constitute the principal portion of the grain. Carbo-

hydrates supply the fuel for the heat and energy of the body, and when there is an excess, it is stored in the body as fat. This fat may be used afterwards when there are not enough carbohydrates supplied in the food.

The fat in the food is the same as you understand it in the ordinary sense of the word. Fat, in greater or less quantities, is found in almost all our plants. Cotton seed contains a high per cent. of fat. This fat may be used by the animal to supply heat and energy just as was mentioned in regard to starch and other carbohydrates, but in calculating the heat value we multiply the number of pounds of fat by 2.4 because the heat value of the fat is about 2.4 times greater than that of starch, sugar, &c.

We have then practically two kinds of feed stuffs, namely fat forming and muscle forming. The farmer finds it easier to grow plants supplying carbonaceous matter than those supplying protein. Corn, hay, cotton seed hulls and potatoes supply carbohydrates, while pea vines, vetch, clover and cotton seed meal supply protein.

Since protein and carbohydrates should be fed in the proper proportions, to prevent the needless waste of the one or the other, we should know something of the nutritive ratio. Nutritive ratio really means the ratio between the digestible protein and digestible carbohydrates plus fats multiplied by 2.4. Nutritive ratios are spoken of as being wide and narrow, for example 100 pounds of wheat bran contains 12.2 pounds of digestible protein and 45.3 pounds of digestible carbohydrates and fat. The nutritive ratio in this case is 1 : 3.7, which may be considered rather narrow. One hundred pounds of corn contains 7.9 pounds of digestible protein and 76.4 pounds of digestible carbohydrates, nutritive ratio 1 : 9.7, which may be considered rather wide. It is seldom that one kind of food will give the protein and carbohydrates in the proper ratio so that we must combine two or more kinds in order to get best results; that is combine one having a wide ratio with one having a narrow ratio, as cotton seed hulls and cotton seed meal.

The value of a feeding stuff depends upon the amount of *digestible* protein, carbohydrates and fat that it contains. Rye straw contains a high percentage of carbohydrates, but the percentage of digestibility is rather low. The percent of digestible matter is obtained by actually feeding the substance in question and noting the amount digested, as compared with the amount fed. The digestibility of most of our feeding stuffs has been obtained in this way, but some have been obtained by chemical analysis. The following

table gives the amount of dry matter, digestible protein, digestible carbohydrates and digestible fat of some of our common feeding stuffs found in this State:

TABLE NO. 1.

Table Showing Number of Pounds of Digestible Nutrients in 100 Pounds of American Feeding Stuffs.

Name of Feed	Dry matter in 100 Lbs.	Digest. Nutrients in 100 Lbs.		
		Protein	Carbo-hydrates	Ether Extract
Concentrates—	lbs.	lbs.	lbs.	lbs.
Corn, all analyses	89.1	7.9	66.7	4.3
Corn and cob meal	84.9	4.4	60.0	2.9
Corn bran	90.9	7.4	59.8	4.6
Wheat	89.5	10.2	69.2	1.7
High grade flour	87.6	8.9	62.4	0.9
Low grade flour	87.6	8.2	62.7	0.9
Dark feeding flour	90.3	13.5	61.3	2.0
Wheat bran	88.1	12.2	39.2	2.7
Wheat shorts	88.2	12.2	50.0	3.8
Wheat middlings	87.9	12.8	53.0	3.4
Wheat screenings	88.4	9.8	51.0	2.2
Rye	88.4	9.9	67.6	1.1
Rye bran	88.4	11.5	50.3	2.0
Rye shorts	90.7	11.9	45.1	1.6
Oats	89.0	9.2	47.3	4.2
Oat meal	92.1	11.5	52.1	5.9
Oat feed or shorts	92.3	12.5	46.9	2.8
Rice	87.6	4.8	72.2	0.3
Rice hulls	91.8	1.6	44.5	0.6
Rice bran	90.3	5.3	45.1	7.3
Rice polish	90.0	9.0	56.4	6.5
Rice meal	89.8	7.56	45.43	10.13
Carolina rice meal	88.97	7.62	42.91	10.16
Sorghum seed	87.2	7.0	52.1	3.1
Broom corn seed	85.9	7.4	48.3	2.9
Kaffir corn	84.8	7.8	57.1	2.7
Millet	86.0	8.9	45.0	3.2

Name of Feed	Dry matter in 100 Lbs.	Digest. Nutrients in 100 Lbs. Protein	Carbo-hydrates	Ether Extract
	lbs.	lbs.	lbs.	lbs.
Linseed meal, old process	90.8	29.3	32.7	7.0
Linseed meal, new process	89.9	28.2	40.1	2.8
Cotton seed	89.7	12.5	30.0	17.3
Cotton seed meal	91.8	37.2	16.9	12.2
Cotton seed hulls	88.9	0.3	33.1	1.7
Sunflower seed cakes	91.8	31.2	19.6	12.8
Peanut meal	89.3	42.9	22.8	6.9
Peas	89.5	16.8	51.8	0.7
Soja (Soy) bean	89.2	29.6	22.3	14.4
Cow pea	85.2	18.3	54.2	1.1
Roughage—				
Fodder corn, green	20.7	1.0	11.6	0.4
Fodder corn, field cured	57.8	2.5	34.6	1.2
Corn stover, field cured	59.5	1.7	32.4	0.7
Fresh Grass—				
Pasture grasses	20.0	2.5	10.2	0.5
Timothy, different stages	38.4	1.2	19.1	0.6
Orchard grass, in bloom	27.0	1.5	11.4	0.5
Redtop, in bloom	34.7	2.1	21.2	0.6
Sorghum	20.6	0.6	12.2	0.4
Hungarian grass	28.9	2.0	16.0	0.4
Vetch	25.0	4.4	9.2	0.7
Hay—				
Timothy	86.8	2.8	43.4	1.4
Orchard grass	90.1	4.9	42.3	1.4
Redtop	91.1	4.8	46.9	1.0
Soja bean hay	88.7	10.8	38.7	1.5
Oat hay	91.1	4.3	46.4	1.5
Marsh or swamp hay	88.4	2.4	29.9	0.9
Crabgrass hay	89.7	2.2	42.8	0.6
Bermuda grass hay	86.0	6.9	39.0	0.8
Johnson grass	85.7	6.0	41.4	1.2
Straw—				
Wheat	90.4	0.4	36.3	0.4
Rye	92.9	0.6	40.6	0.4
Oat	90.8	1.2	38.6	0.8
Barley	85.8	0.7	41.2	0.6
Wheat chaff	85.7	0.3	23.3	0.5
Oat chaff	85.7	1.5	33.0	0.7

Name of Feed	Dry matter in 100 Lbs.	Digest. Nutrients in 100 Lbs.		
		Protein	Carbo-hydrates	Ether Extract
	lbs.	lbs.	lbs.	lbs.
Fresh Legumes—				
Red clover, different stages	29.2	2.9	14.8	0.7
Alsike, in bloom	25.2	2.7	13.1	0.6
Crimson clover	19.1	2.4	9.1	0.5
Alfalfa	28.2	3.9	12.7	0.5
Cowpea	16.4	1.8	8.7	0.2
Soja bean	24.9	3.2	11.0	0.5
Legume, Hay and Straw—				
Red clover, medium	84.7	6.8	35.8	1.7
Red clover, mammoth	78.8	5.7	32.0	1.9
Alsike clover	90.3	8.4	42.5	1.5
White clover	90.3	11.5	42.2	1.5
Crimson clover	90.4	10.5	34.9	1.2
Lespedeza striata	86.0	7.8	41.4	1.8
Peanut hay	92.4	6.7	42.1	3.4
Alfalfa	91.6	11.0	39.6	1.2
Cowpea	89.3	10.8	38.6	1.1
Soja bean straw	89.9	2.3	40.0	1.0
Peavine straw	86.4	4.3	32.3	0.8
Vetch hay	83.3	14.6	30.6	2.3
Silage—				
Corn	20.9	0.9	11.3	0.7
Clover	28.0	2.0	13.5	1.0
Sorghum	23.9	0.6	14.9	0.2
Alfalfa	27.5	3.0	8.5	1.9
Cowpea vine	20.7	1.5	8.6	0.9
Soja bean	25.8	2.7	8.7	1.3
Roots and Tubers—				
Potatoes (sweet)	28.9	0.9	22.2	0.3
Beet, common	13.0	1.2	8.8	0.1
Beet, sugar	13.5	1.1	10.2	0.1
Beet, mangel	9.1	1.1	5.4	0.1
Flat turnip	9.5	1.0	7.2	0.2
Ruta-baga	11.4	1.0	8.1	0.2
Artichoke	20.0	2.0	16.8	0.2
Miscellaneous—				
Cabbage	15.3	1.8	8.2	0.4
Sugar beet leaves	12.0	1.7	4.6	0.2

Name of Feed	Dry matter in 100 Lbs.	Digest. Nutrients in 100 Lbs. Protein	Carbo-hydrates	Ether Extract
	lbs.	lbs.	lbs.	lbs.
Pumpkin, field	9.1	1.0	5.8	0.3
Pumpkin, garden	19.2	1.4	8.3	0.8
Cow's milk	12.8	3.6	4.9	3.7
Cow's milk, colostrum	25.4	17.6	2.7	3.6
Skim milk, gravity	9.6	3.1	4.7	0.8
Skim milk, centrifugal	9.4	2.9	5.2	0.3
Buttermilk	9.9	3.9	4.0	1.1
Whey	6.6	0.8	4.7	0.3

USE OF TABLE.

It has been found by practice and experiments, that an animal of 1,000 pounds live weight will require a certain amount of protein, carbohydrates and fat, in order to do a certain amount of work. This work may be actual labor, putting on fat or giving milk. Then the more work the animal is required to do, the more food it will require, just as a large crop requires plenty of plant food to produce it. The table below gives the feeding standards for different animals. The standards as given are not absolutely correct but they serve as guides. The reason why they are not absolutely correct is that some animals will make better use of the food given them than others of like weight, in other words they may have the power of digesting more of a given amount of food than other animals. Breed has nothing to do with the ability of an animal to digest food.

TABLE NO. 2.—FEEDING STANDARDS.

Animal	Per Day per 1000 lbs. Live Wt.				
	Dry Matter.	Digestible Nutrients			
		Protein	Carbo-hydrates	Ether Extract	Nutritive Ratio, 1:
	lbs.	lbs.	lbs.	lbs	lbs.
1. Fattening Cattle—					
First period......	30.	2.5	15.0	0.5	6.5
Second period	30.	3.0	14.5	0.7	5.4
Third period.....	26.	2.7	15.0	0.7	6.2
2. Milch Cows—					
When yielding daily					
11.0 lbs. of milk...	25.	1.6	10.0	0.3	6.7
16.6 lbs. of milk...	27.	2.0	11.0	0.4	6.0
22.0 lbs. of milk...	29.	2.5	13.0	0.5	5.7
27.5 lbs. of milk...	32.	3.3	13.0	0.8	4.5
3. Sheep—					
Coarse wool......	20.	1.2	10.5	0.2	9.1
Fine wool	23.	1.5	12.0	0.3	8.5
4. Horses—					
Light work......	20.	1.5	9.5	0.4	7.0
Medium work	24.	2.0	11.0	0.6	6.2
Heavy work......	26.	2.5	13.3	0.8	6.0
5. Brood sows......	22.	2.5	15.5	0.4	6.6
6. Fattening Swine—					
First period......	36.	4.5	25.0	0.7	5.9
Second period	32.	4.0	24.0	0.5	6.3
Third period.....	25.	2.7	18.0	0.4	7.0
7. Growing Swine— Breeding Stock					
Age in mo Av live wt.					
2-3......50 lbs...	44.	7.6	28.0	1.0	4.0
3-5.....100 lbs...	35.	5.0	23.1	0.8	5.0
5-6.....120 lbs...	32.	3.7	21.3	0.4	6.0
6-8.....200 lbs...	28.	2.8	18.7	0.3	7.0
8-12....250 lbs...	25.	2.1	15.3	0.2	7.5
8. Growing Fattening Swine—					
2-3......50 lbs...	44.	7.6	28.0	1.0	4.0
3-5.....100 lbs...	35.	5.0	23.1	0.8	5.0
5-6.....150 lbs...	33.	4.3	22.3	0.6	5.5
6-8.....200 lbs...	30.	3.6	20.5	0.4	6.0
9-12....300 lbs...	26.	3.0	18.3	0.3	6.4

Now, in the standard we say that a milch cow of 1,000 pounds live weight, giving 22 pounds of milk per day, will require 29 pounds of dry matter containing 2.5 pounds of digestible protein, 13.0 pounds of digestible carbohydrates and 0.5 pounds of fat each 24 hours. In order to get the proper amounts of each, it is necessary to have a combination of foods. You notice that the standard calls for 29 pounds of dry matter, this is necessary in order to insure sufficient bulk to the ration. The cow will not make the best use of the food if it is all supplied in a concentrated form.

In order that we may have a clear idea of the construction of rations let us suppose we want to construct a ration for the cow mentioned above. We will take some of the common feeding stuffs, say corn silage, bran, cotton seed meal, corn meal and hulls. We will take as a trial ration corn silage 30 pounds, bran 6 pounds, cotton seed meal 3 pounds and corn meal 4 pounds. Looking these up in the table we find that corn silage contains 20.9 per cent of dry matter; then in the 30 pounds of silage we will have 6.27 pounds of dry matter. We find that it contains 0.9 per cent. of protein; then in the 30 pounds we will have 0.27 pounds of protein. We find that it contains 13.3 per cent. of carbohydrates; in the 30 pounds then there will be 3.39 pounds of digestible carbohydrates, and since corn silage contains 0.7 per cent. of fat there will be 0.21 pounds of fat in the 30 pounds. If we work all of them out in this way, and put them down in tabular form, we will have the following as a trial ration:

Kind of Feed	Wt.	Pounds of Dry Mat.	Pounds of Protein.	Pounds of Carbot'es.	Pounds of Fat.
Corn silage. . . .	30	6.27	0.27	3.39	0.21
Bran.	6	5.29	0.74	2.35	0.16
Cot. seed meal. .	3	2.75	1.12	0.51	0.37
Corn meal	4	3.56	0.32	2.67	0.09
Total.		17.87	2.45	8.92	0.83

Comparing this with the standard we find:

	Pounds of Dry Mat.	Pounds of Protein.	Pounds of Carbot'es.	Pounds of Fat.
Standard	29.0	2.5	13.0	0.5
Proposed ration	17.87	2.45	8.92	0.83
Difference	—11.13	—0.05	—4.08	-|-0.33

Thus we see that we need about 11 pounds of dry matter, 4.08 pounds of digestible carbohydrates and a very small amount of protein to bring the ration up to the standard, but we have 0.33 pounds of fat too much. We will not bother about this excess of fat as the carbohydrates are still too low. In order to bring the ration up to the standard we will try 12 pounds of hulls. Adding this to the proposed ration we have:

	Pounds of Dry Mat.	Pounds of Protein.	Pounds of Carbot'es.	Pounds of Fat.
Proposed ration	17.87	2.45	8.92	0.83
C. S. hulls, 12 lbs ..	10.67	0.04	3.97	0.20
Total........	28.54	2.49	12.89	1.03

This brings the ration sufficiently near the standard for all practical purposes. As said above the standard is nothing more than a guide. You may find from experience that your animals will do better on slightly more protein than is given in the standard. Experience should be combined with the use of the standard.

Remember that the above ration is for an animal of 1,000 pounds live weight. If your animal is larger or smaller, vary the amount of the ration to suit the size. Judgment must be exercised in selecting the kinds of food to use; for example, cotton seed meal should not be used to supply protein to young calves or pigs.

In feeding dairy cows it is well to have a variety of food so that the cows will not tire of any one kind. The object in feeding the dairy cow or the fattening steer is to convert the raw product of the farm into milk and butter or beef. It takes a certain amount of food to keep up the body. This must be supplied before any milk or fat can be made. All over and above what the animal requires to maintain the body is converted into profit to the feeder. It is evident then that the more you can get the animal to eat and digest, the greater profit it will return.

The palatability of the food should be taken into consideration. It makes no difference how high a feeding value a plant may have, if it is not palatable. A very small amount of food that an animal is fond of mixed with other food of which she is not fond, will sometimes make the whole more palatable: for example, a little green rye mixed with the other food in the spring will make the food more palatable.

The following rations made up of our common feeding stuffs are suggested as being suitable for dairy cows in the South.

No. 1. Cotton seed hulls 20 pounds, corn meal 8 pounds, and cotton seed meal 5 pounds.

No. 2. Crab-grass hay 10 pounds, cow pea hay 10 pounds, and corn and cob meal 10 pounds.

No. 3. Corn ensilage 30 pounds, bran 6 pounds, cotton seed meal 3 pounds, and cotton seed hulls 12 pounds.

No. 4. Crab-grass hay 20 pounds, corn stover 12 pounds, corn meal 3 pounds, and cotton seed meal 3 pounds.

No. 5. Corn stover 18 pounds, wheat bran 4 pounds, cotton seed meal 4 pounds, and corn meal 6 pounds.

No. 6. Sweet potatoes 25 pounds, corn stover 10 pounds, cotton seed meal 4 pounds, and corn meal 8 pounds.

N[illegible] Corn shucks 12 pounds, cow pea hay 10 pounds, corn meal [illegible] pounds, and cotton seed meal 3 pounds.

No. 8. Vetch hay 14 pounds, cotton seed hulls 10 pounds, and corn meal 6 pounds.

No. 9. Cow pea hay 15 pounds, shredded corn stalks 10 pounds, cotton seed meal 2 pounds, and corn meal 2 pounds.

No. 10. Corn shucks 25 pounds, cotton seed meal 5 pounds, and wheat bran 3 pounds.

No. 11. Cotton seed hulls 20 pounds, cotton seed meal 4 pounds, and wheat bran 5 pounds.